FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN

PER ORBEM

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THE SMITHSONIAN SERIES

Editor-in-chief

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Secretary of the Smithsonian Institution

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FOREWORD

TO THE

SMITHSONIAN SCIENTIFIC SERIES

In preparing these volumes for popular sale, the Smithsonian Institution has been actuated by two motives: first, the desire to diffuse knowledge more widely; and second, the desire to supplement its own inadequate resources for the increase of knowledge.

Concerning the first of these, it is a fundamental article of faith with the Institution that the value of knowledge increases with the number of people who share in it. For it has no significance except in relation to human beings, and the more of these it lifts to view a broader horizon, the more tolerant and understanding will become the collective human mind. And knowledge is like seed in this—the greater the quantity sown, the greater will be the yield.

So much for the first motive. Of the second, the history of the Institution stands as a justification. Out of an Englishman's gift of a half million dollars, made a century ago, Smithsonian husbandry has caused to grow public services like the Weather Bureau, the Bureau of Fisheries, the National Museum, and others, whose value to the country cannot be estimated in dollars. The Institution has a right to believe that such stewardship of its one talent in the past entitles it to the care of the many more talents which modern conditions make necessary to the continuation of its labors.

Wm H Taft

Chancellor.

PREFACE

TO THE

SMITHSONIAN SCIENTIFIC SERIES

SINCE the foundation of the Smithsonian Institution its hundreds of volumes of technical papers have supplied new tools to the specialist, while the Annual Reports have met the requirements of the general public for non-technical discussions of scientific subjects. The Institution has aimed at two goals for its publications: that they should be authoritative, and that they should be accessible. To this latter end the rule of distribution without charge or, in rare cases, at cost has been rigidly adhered to.

The present Series represents the only departure from this rule. I wish to emphasize that it is an exception and that the traditional policy of free distribution of the Smithsonian's regular publications will in no wise be changed.

The Smithsonian Scientific Series takes its place in the field in which the Institution had hitherto been represented almost solely by the Annual Reports. It is intended to enlighten and interest the general reader. It does not represent an attempt to summarize all science, or even all branches of science on which the Smithsonian can speak with authority. It will, however, acquaint the reader with the organization, history, and activities of the scientific institution which has grown up with the nation and fostered the nation's scientific activities; it will introduce him to the workings and achievements of the scientific method over a large field, and open doors to some branches of science to which he will not find the key elsewhere.

C. G. ABBOT,
Secretary.

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PART I

A BIRD'S-EYE VIEW OF THE SMITHSONIAN AND A VISIT TO ITS HALLS

PLATE 1

Airplane view of Smithsonian group of buildings on the Mall in Washington. In middle foreground, Smithsonian Building; beyond and slightly to the left, Natural History Building, and on right lower edge, Arts and Industries Building of the National Museum. Freer Gallery of Art on lower left edge; Aircraft Building on lower edge, center

CHAPTER I

WHAT IS THE SMITHSONIAN?

In the Smithsonian Institution, America perpetuates the name of an Englishman. He was an Englishman who never saw America, who never, until he made his will, betrayed any special interest in the young Republic across the seas. Neither was he a man known widely for any great achievement. Yet his name will endure as long as the Government of the United States endures. No irony of chance need be looked for in this reward to modest James Smithson of England; there is in it, rather, a subtle and profound justice. Far in advance of the mass of even intelligent thought, James Smithson had faith that "no ignorance is without loss to man, no error without evil." A disciple of the scientific method of patient observation, of measuring, of weighing, and of correlating, he spent his life in its application to decrease the boundaries of ignorance, and on his death he consecrated his fortune to the perpetuation of his faith, making young America his trustee. In the course of years, materially inspired and aided by Smithson's bequest, the United States has come to accept as one of its motivating faiths the faith of James Smithson, while the key to the nation's most typical contemporary achievements—in business organization, in education, in relations between labor and capital—is to be found in the application of the scientific method, which James Smithson's gift to America helped so much to propagate. And therein lies the fitness of our recognition of this Englishman.

Smithson's gift had a timeliness rarely met with in the annals of nations. He died in 1829, willing his fortune of $542,000, conditionally on the death of his nephew without heirs, to the United States of America, to found at Washington an establishment to be called the Smithsonian Institution, "for the increase and diffusion of knowledge among men." The money reached this country in 1838. Congress spent eight years in sporadic debate on how best to increase and diffuse knowledge among men, thus delaying the establishment of the Institution until 1846.

At that time the United States constituted a scientifically unknown area, enclosing in a single geographical and political unit a prolific plant and animal life ready under the most favorable conditions to reveal their secrets to botanists and zoologists; a country peopled by a primitive race, illustrating the mode of life and habits of thought of prehistoric man and offering a priceless clue to the lost story of man's climb upward. At the same time, in the hands of an energetic people possessed of a freedom not before known to history, untrammeled by tradition, and putting a premium on the initiative of the individual, were the mechanical tools, particularly steam transportation, capable of developing this new continent. In fact, the country was on the eve of a dynamic expansion westward which, with the suddenness and the energy of a tidal wave, was to subdue two thousand miles of wilderness.

Such a setting and such men to deal with it offered possibilities for the increase of knowledge such as perhaps the world had never before seen. The danger was that the men would remain blind to those possibilities and waste the setting for practical ends without thought of its perishable secrets. The need was for some powerful, inspiring force, actuated by the highest ideal of knowledge for its own sake, which would be conscious of the possibilities and which would devote its energies to making

the most of them. That force the liberality of the Englishman, James Smithson, helped to supply.

Congress made two invaluable gifts to the emerging Institution—prestige and stability—the former by accepting the trusteeship of the Smithsonian, and the latter by creating an unimpeachable governing board. The Establishment, an inactive body, includes the President, Vice President, Chief Justice, and the Cabinet; the Board of Regents, which actually governs the Institution, includes the Vice President and Chief Justice, three Senators, three Representatives, and six private citizens chosen by Congress.

In spite of this close and mutually profitable relationship with the Government, the Smithsonian Institution remains essentially a private establishment, enjoying the freedom of action derived from independent funds. True, in addition to its own income, the Institution oversees the expenditure of Government funds, but this is because Congress continues to entrust to its care several public bureaus which developed from the private initiative of the Smithsonian. They include the National Museum, the Bureau of American Ethnology, the Astrophysical Observatory, including the Division of Radiation and Organisms, the International Exchange Service, the National Zoological Park, and the National Collection of Fine Arts. The National Gallery of Art, opened in 1941, is a bureau of the Smithsonian but is administered by a separate board of trustees. The Weather Bureau and the Bureau of Fisheries also grew out of private Smithsonian activities, but they are no longer administered by the Institution.

Following the lead of the Government, several private citizens have likewise entrusted great administrative responsibilities to the Smithsonian; notably Charles Lang Freer, who made the Institution his heir and confided his Oriental and American art treasures to its keeping in the Freer Gallery; Thomas G. Hodgkins; John A. Roebling; John Gellatly; and others.

The man immediately in charge of the great administrative organization here outlined, is called, like the men at the head of the Government departments, the Secretary. Since its establishment in 1846, five secretaries have controlled the destinies of the Smithsonian. Each has been a man of international standing in science. First came the physicist, Joseph Henry, 1846 to 1878. A contemporary and peer of Faraday, Henry gave up his own brilliant career of discovery in electricity and magnetism to shape the policy of the Smithsonian. Of another scientist's life we should recount the profound researches and the classic publications. Henry's electromagnetic discoveries were indeed of such importance as to cause his name to be given to the international unit of electric self-induction, just as Faraday's is to the unit of electric capacity. But Henry's greatest experimental research was his development of the Smithsonian Institution; his classic publications form its *Reports*.

Then followed Spencer Fullerton Baird, naturalist, Assistant Secretary, 1850 to 1878; Commissioner of Fisheries, 1870 to 1887; and Secretary, 1878 to 1887. Baird carried several men's work continuously, and was not only the foremost authority of his time on birds, snakes, and fishes, but also the father of the National Museum and the U. S. Fish Commission. We owe it primarily to him that America's fisheries are now flourishing.

After Baird came Secretary Samuel Pierpont Langley, astronomer and physicist, 1887 to 1906. Langley organized epoch-making researches on the solar rays. Later on he rescued the study of mechanical flight from ridicule and, after experimentally developing the art, as early as 1896 he flew large power-models, heavier than air, for long distances. Langley established the Astrophysical Observatory of the Smithsonian Institution, which still carries on his researches on solar rays, and he also was the prime mover in founding the National Zoological Park.

Fourth came Secretary Charles Doolittle Walcott, geolo-

gist, 1907 to 1927, foremost investigator of the most ancient life of our world, revealed as Cambrian fossils. He headed the U. S. Geological Survey for fifteen years before assuming the Secretaryship of the Smithsonian. Valued advisor to leaders of the Government during many administrations, irrespective of their politics, as well as member and President of the National Academy of Sciences, he was a potent force in all the effective movements for conservation of natural resources for nearly forty years.

The fifth and present Secretary is Dr. Charles Greeley Abbot, astrophysicist.

Such is the Smithsonian Institution, and such its leaders during its long history. The following list of activities presents a bird's-eye view of the place it fills:

1. It carries on original scientific investigations by its own staff, taking part in expeditions for research in all parts of the world.

2. It prints large memoirs and smaller original papers, publishes useful tables and formulas, and reprints informing articles on scientific progress suitable for the intelligent general reader, and distributes these free to libraries, to scientific and learned societies, and to individuals throughout the world.

3. It administers six public governmental bureaus and also the Freer Gallery.

4. It subsidizes approved researches by outside workers.

5. It is the official channel of exchange of scientific intelligence between the United States and the world.

6. It fosters scientific development of schools, museums, and institutions throughout the world by cooperation in the loan of research men, in the free distribution of over a million specimens, and in giving its advice and its publications.

7. It maintains at the Library of Congress probably the foremost scientific library in this country, consisting chiefly of the transactions of learned societies and scientific

journals from the entire world, and numbering more than 500,000 volumes.

8. It answers by mail an average of 8,000 inquiries on scientific subjects annually, gratis.

9. It gives occasional lectures and courses of lectures by eminent scientists.

10. It confers medals of honor on eminent discoverers.

11. It procures foreign diplomatic and learned recognition and assistance for expeditions going abroad.

12. It is the headquarters of the American Association for the Advancement of Science and the American Association of Museums. Until 1924, it was the headquarters and meeting place of the National Academy of Sciences.

13. It disburses annually funds from four sources which in recent years average as follows:

(a) The income of its endowment, $80,000.
(b) Sums entrusted by private individuals for special objects, $90,000.
(c) The income of the Freer bequest, $233,000.
(d) Congressional appropriations for six public bureaus, $1,300,000.

CHAPTER II

THE UNITED STATES NATIONAL MUSEUM

A CENTURY ago the animals, plants, and natural features of our country were little known; and the Indian race of men, foreign to all the traditions and history of the old world, occupied the great West. The new world was soon to be remodeled by the white race, its features changed, and its aboriginal inhabitants, both men and animals, largely exterminated. Fortunately, there were two farsighted scientific men, Secretary Henry and Assistant Secretary Baird of the Smithsonian Institution, who recognized the unique opportunity. They interested army surgeons and young officers in the lonely frontier army posts; surveyors and explorers of new routes of travel; pioneers in the new homes of the West. Methods of collecting specimens were worked out, instruments and materials furnished, letters of encouragement and enthusiasm written by hundreds to inspire and aid these amateur collectors. By such means, before it was forever too late, a flood of specimens came to the Smithsonian, and the United States National Museum was created by the Institution. After twelve years Congress began to help little by little in its maintenance and now provides its finances almost completely as for a public necessity. Visitors suppose that the exhibition halls are its primary end, but this is not the case. The immense numbers of specimens in the study collections that the average visitor never sees contain the documents of our country's natural history and the sources of fundamental knowledge on

which depend wealth and progress. Yet the exhibitions, though of less importance to science, are full of interest.

Walking through the halls of the Natural History Building, surrounded by exhibits of animals and birds, rocks, and minerals, and the races of man of every degree of civilization; and through the galleries of the Arts and Industries Building, containing records of great inventions, beautiful textiles and fabrics, mementos of great men and great events in the history of America—from this numerous assemblage of objects, each one carefully labeled, and the whole arranged with a definite plan and purpose, the visitor receives an impression of incredible variety. Months would not suffice to disclose all that should interest him. And yet what the visitor sees in the exhibition halls is but a very small proportion of the collections of the National Museum. While the objects on exhibition may be counted in thousands, those in the storage and study series must be reckoned in millions.

Next to the great magnitude and scope of the collections, the feature that is apt to strike the visitor most forcibly is the realism achieved in the larger exhibits. In the department of ethnology, the groups of American Indians, Eskimo, Fiji Islanders, and many other races of man, are so arranged as to present a faithful picture of these peoples as they appear in their natural surroundings. The figures themselves have been modeled by men skilled in this art, after careful study of living subjects; the costumes they wear are actual native products collected on the spot; and the groups are shown engaged in familiar occupations characteristic of the particular race or tribe. The visitor hardly refrains from questioning the figures as if they were real people.

In the animal groups, the same attention to detail results in lifelike poses, the result of long study of living animals in their native haunts by the taxidermists and the curators in charge. The setting for the group, such

PLATE 3

Alexander Wetmore, Assistant Secretary of the Smithsonian Institution, in charge of the National Museum

PLATE 4

Realism in the animal groups, National Museum. Water buffalo collected by the Smithsonian-Roosevelt African Expedition, 1909

as a water hole, a clump of trees or bushes, is so real that we almost sniff the odor of the natural surroundings.

Similarly exact reproduction prevails in the division of mineral technology. An incident which occurred in this division will illustrate how far this endeavor to achieve realism has succeeded. A section of a mine, with galleries, timbers, and ore, had been transferred bodily from a mine in the West and set up in a space assigned to it in the Arts and Industries Building. In a dark corner, arranged for visitors to appreciate the actual conditions under which mining is carried on, is a shaft. In the real mine it leads down to the next lower level of the mine, but in the Museum it is only about two feet in depth. Its dark and yawning mouth led one lady visitor to believe that the shaft continued down into the bowels of the earth. Having dropped her hat into the hole, she did not even trouble to leave an inquiry with the guards, thinking her hat was gone beyond recall. The watchman found it about two feet below the floor at the bottom of the dummy shaft.

The Museum is thought of by most people simply as a place where beautiful, strange, and instructive things are displayed for the public amusement and interest. This, indeed, is an important function. Scarcely anything else in Washington attracts so much attention from those who come from distant states to the Nation's Capital. Every year, in springtime, troops of school children fill the Museum halls and carry away with them lifelong impressions. For they see there things once possessed by the great men of America; the gowns worn by the wives of the Presidents; the choice specimens of African animals collected by ex-President Theodore Roosevelt; Indian figures grouped at their occupations in a way so lifelike as to seem real; remains of prehistoric animals of monstrous proportions; the original models constructed by the Nation's greatest inventors; the captured ordnance and

many other relics of the great wars of the Nation. Such things are found telling their story on every hand.

Yet after all, as we have said, it is even more in the unseen part of the National Museum that its greatness consists. In the laboratories and offices outside of the exhibition halls are preserved many millions of specimens which embody no small share of the world's knowledge of life and of material resources.

Experts, whom the visitors to the exhibits rarely see, are there, arranging, microscopically examining, classifying, and describing the specimens. Thousands of letters are answered, coming from students and inquirers all over our country and the world. Well-arranged collections are being prepared for smaller museums and schools. Skillful artisans are chipping away the solid rock which holds the fragile bones of fossil monsters, or mounting birds and insects, animals, or reptiles in lifelike poses.

The knowledge acquired by these experts is highly valuable to the country. Even fossils too small to be seen with the naked eye have uses valued in millions of dollars. For a knowledge of certain species and the relations these have to oil-bearing strata has been a factor in bringing about the greatest improvement in the technique of locating oil wells. As another example, in a lawsuit involving a cargo of mahogany valued in hundreds of thousands of dollars, the expert knowledge of the habits of African shipworms possessed by one of the Museum staff proved the Government's case. For he was able to show convincingly that the lumber in question was certainly riddled by the worms during its two-months' stay in the salt marshes of Africa, and not in the hold of a Government ship.

Insects, some harmful, others highly favorable to agriculture or to health, are preserved by millions for study by the experts of the Government agricultural department. Plants representing our whole American flora and much of foreign flora are collected. Rocks, and a knowl-

edge of their properties, and their relations to gems, ores, oil, and building stones are expertly classified. In a word, the basis of useful knowledge which forms the backbone of textbooks and encyclopedias is preserved and made available in the National Museum. Someone has truly said that no textbook has been published in the past half-century that does not depend for many of its facts on the work of the Smithsonian and the National Museum.

In the exhibition halls devoted to anthropology are seen the groups of American Indians and many other primitive races. We can learn more about the primitive ways of fire making by observing the figure of an Indian crouching over his twirling stick than by reading a dozen articles on the subject. We see the Indian craftsmen and women weaving their blankets, shaping arrowheads, making baskets; the Indian children playing native games; and the hunters setting out for the chase with their primitive weapons. The Indian groups include not only the tribes of the United States, but also those of the great north woods of Canada, the natives of Alaska, and the Eskimo of the frozen regions north of the Arctic Circle; in the other direction, the tribes of Mexico and of Central and South America are illustrated. In another hall are shown the primitive peoples of the Pacific Islands, the East Indies, Australia, Africa, and Asia.

As the origin of man and his earliest efforts to gain advantage over other animals and over the forces of nature are of absorbing interest, we turn aside to see the exhibit of skeletal remains and artifacts of prehistoric man. Here are found facsimiles of the celebrated fossil human bones of Dubois's *Pithecanthropus*, the men of Neanderthal and Spy, the South African man, and originals or casts of many more. These are shown so as to be compared each to each and to the corresponding skeletal forms of various types of modern man and apes. The stone and bone implements found at different geological horizons too are here. Thus the visitor may see for himself those

evidences regarding man's progress about whose interpretation so fierce a battle has raged in recent years. As we pass along we are apt to exclaim in astonishment as we see ancient Peruvian skulls from which pieces of bone were cut by ancient surgeons with no instruments other than sharp stones. And yet, in many instances, as the healed surfaces prove, the patients recovered.

In American archeology the exhibits include objects illustrating the skill of the prehistoric craftsmen of this country and of the American countries to the north and south of us. There are pottery bowls of greatly diversified shapes and often of beautiful color and symmetry, implements and weapons of bone and stone, blankets in complex patterns and other examples of the primitive weaver's art. These things and many more represent the native arts and industries of prehistoric America. In Mexico and the countries south of it, the ancient culture reached its highest development, and specimens of their elaborate sculpture and carving from temples and pyramids, and their gorgeous costumes show how nearly those Indians rivaled the early products of Oriental civilization.

The Old World is also well represented by archeological exhibits, including the extremely primitive stone axes and other implements of the stone age of Europe, Asia, and other parts of the world; pottery and works of art in stone from ancient Greece and Rome; aboriginal artifacts from Syria, Babylonia, and Egypt, including mummies, sculptures, and monuments; and very ancient glassware from the countries bordering the Mediterranean.

The practices of the various religions of the races of man form another series of exhibits under the department of anthropology. These objects illustrate the varied and often weird rites of seven of the great religions of history, namely: Christianity, Judaism, Buddhism, Mohammedanism, Hinduism, Parseeism, and Shintoism.

The largest and most striking unit in the department of anthropology, indeed one of the most important col-

PLATE 5

Section of copper mine in the National Museum. This stope was transferred bodily from the Copper Queen Mine in Arizona

PLATE 6

Storage and workroom, division of mammals, National Museum, typical of laboratories where the study collections are kept and where the Museum's research is conducted

lections ever received by the Smithsonian, is the Herbert Ward African Collection, presented to the Institution in 1921. This collection, which is displayed in a hall specially prepared for it by the head curator in collaboration with Mrs. Ward, consists of a number of remarkable sculptures by Mr. Ward of the natives of Africa, and a large assemblage of native implements, weapons, art objects, wood carvings, fabrics, musical instruments, and other products. Doctor Holmes, then Director of what is now the National Collection of Fine Arts, in describing the effect produced by the exhibit, wrote:

"The impression given by the first glimpse of the dark bronze figures and groups of figures, as one after another they come into view in the rather dimly lighted gallery, is that of the weird and mysterious, with a distinct suggestion of the dramatic or even of the tragic, and this impression is intensified as one catches glimpses of the walls glistening with a confused, yet beautifully arranged array of strange implements and sinister-looking weapons. The observer marvels at the extent of the exhibit. That one man in a lifetime of wanderings in Africa, even with subsequent additions, could have gathered together even the half of these things almost challenges belief."

On March 4, 1908, Theodore Roosevelt left the White House. For the exponent of "the strenuous life" it was impossible to be at hand without commanding. Therefore Roosevelt looked about the world for the remotest place from the American Presidency, and he chose darkest Africa. But it was no mere retirement to a well-merited rest that allured him. He must be doing something unusual. Other men made hunting trips, but he with the cooperation of Secretary Walcott of the Smithsonian, organized the Roosevelt African Expedition to collect great animals for the National Museum. Everything Roosevelt did has still its glamour, so that the crowd continues to frequent the mammal hall, to see the "Roosevelt African Collection."

Here we come upon the great glass-sided cases where sleep the rhinoceros and hippopotamus, recalling the famous passage in Job:

"Behold now behemoth which I made with thee; he eateth grass as an ox. Lo, now his strength is in his loins, and his force is in the navel of his belly. . . . His bones are as strong pieces of brass; his bones are like bars of iron. . . . He lieth under the shady trees, in the covert of the reed, and fens. . . . Behold he drinketh up a river, and hasteth not: he trusteth that he can draw up Jordan into his mouth."

Here, too, are the monstrous giraffes whose long necks and legs carry their little heads almost to touch the ceiling of this high hall. Here are the lions, and we are reminded of David Livingstone and his terrible adventure:

"When in the act of ramming down the bullets I heard a shout, and looking half round, I saw the lion in the act of springing upon me. He caught me by the shoulder, and we both came to the ground together. Growling horribly, he shook me as a terrier does a rat. . . . It caused a sort of dreaminess in which there was no sense of pain nor feeling of terror, though I was quite conscious of all that was happening. . . . Mabálwe was aiming at him from a distance of ten or fifteen yards. His gun, which was a flint one, missed fire in both barrels. The animal immediately left me to attack him, and bit his thigh. Another man, whose life I had saved after he had been tossed by a buffalo, attempted to spear the lion, upon which he turned from Mabálwe and seized this fresh foe by the shoulder. At that moment the bullets the beast had received took effect, and he fell down dead. . . . Besides crunching the bone into splinters, eleven of his teeth had penetrated the upper part of my arm. . . . I have escaped with only the inconvenience of a false joint in my limb. The wound of the man who was bit in the shoulder actually burst forth afresh on the same month of the following year."

The exhibits of the Roosevelt Expedition, arranged in lifelike groups, including the zebras, the lions, the buffalo, and the rhinoceros as they appear in their native haunts, represent the finest product of the taxidermist's skill. Other interesting African mammals resulting from various expeditions include the giraffes, antelopes, gorillas, leopards, baboons, wild boars, and hyenas. The remarkable fauna of Australia is represented in the Museum by several varieties of kangaroos, those queer-looking animals whose tail serves practically as a fifth leg and who carry their children in pouches; the peculiar wild dog of Australia known as the dingo; the echidna, and the curious duck-billed platypus, remarkable as being the only mammals which lay eggs. From the Orient are shown the zebu, or sacred cattle of India; the beautiful Bengal tiger, the wild hog or babirussa of Borneo; and several groups of Primates, including the ferocious-looking orang-utan, the gibbon, and the proboscis monkey.

From the Palearctic region, many rare and curious mammals are exhibited, including the tiger of Manchuria, the long-tailed deer of China, the ibex and chamois, the almost extinct European bison, and the great wild sheep of Central Asia. The exhibit of native North American mammals contains perhaps the finest groups of all, the moose, bison, Rocky Mountain sheep and goats, elks, caribou, musk-ox, various species of bear, the pronghorn, and the aquatic mammals, represented by groups of walrus, seals, and whales. The whales, the largest animals on the earth today, are given a hall to themselves. The exhibit includes a 78-foot skeleton of a sulphur-bottom whale, and a model seventy-three feet long of the same species, made directly from parts of an animal killed in Newfoundland, together with a collection of the implements used in capturing whales.

The National Museum has a very complete collection of birds. Of the 2,810 kinds listed in the British Museum's "Handlist of the Genera and Species of Birds," only 92

are lacking in the Museum collection. Only a small proportion can be shown to the public in the exhibition halls; the large majority are kept in the study series, where they are almost constantly in use by students of various problems connected with birds. Particularly interesting among those on exhibition are the birds which through various causes have become extinct and will never again be seen in flight. These include the passenger pigeon, the great auk, and the Labrador duck, as well as a form which is on the verge of extinction—the Carolina parrakeet.

The celebrated naturalist, Audubon, has given the following account of the myriads of passenger pigeons which formerly inhabited the United States:

"Let us now, kind reader, inspect their place of nightly rendezvous. One of these curious roosting places, on the banks of the Green River in Kentucky, I repeatedly visited. It was, as is always the case, in a portion of the forest where the trees were of great magnitude, and where there was little underwood. I rode through it upward of forty miles, and, crossing it in different parts, found its average breadth to be rather more than three miles. My first view of it was about a fortnight subsequent to the period when they had made choice of it, and I arrived there nearly two hours before sunset. Few pigeons were then to be seen, but a great number of persons, with horses and wagons, guns and ammunition, had already established encampments on the borders. Two farmers from the vicinity of Russellville, distant more than 100 miles, had driven upward of 300 hogs to be fattened on the pigeons which were to be slaughtered. Here and there, the people employed in plucking and salting what had already been procured, were seen sitting in the midst of large piles of these birds. The dung lay several inches deep, covering the whole extent of the roosting place, like a bed of snow. Many trees two feet in diameter, I observed, were broken off at no great distance from the ground, and the branches of many of the largest and

tallest had given way, as if the forest had been swept by a tornado. Everything proved to me that the number of birds resorting to this part of the forest must be immense beyond conception. As the period of their arrival approached, their foes anxiously prepared to receive them. Some were furnished with iron pots containing sulphur, others with torches of pine knots, many with poles, and the rest with guns. The sun was lost to our view, yet no pigeon had arrived. Everything was ready, and all eyes were gazing on the clear sky, which appeared in glimpses amid the tall trees. Suddenly there burst forth a general cry of 'Here they come!' The noise which they made, though yet distant, reminded me of a hard gale at sea passing through the rigging of a close-reefed vessel. As the birds arrived, and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the pole men. The birds continued to pour in. The fires were lighted, and a magnificent, as well as wonderful and almost terrifying sight presented itself. The pigeons, arriving by thousands, alighted everywhere, one above another, until solid masses as large as hogsheads, were formed on the branches all round. Here and there the perches gave way under the weight with a crash, and falling to the ground, destroyed hundreds of the birds beneath, forcing down the dense groups with which every stick was loaded. It was a scene of uproar and confusion. I found it quite useless to speak, or even to shout to those persons who were nearest to me. Even the reports of the guns were seldom heard, and I was made aware of the firing only by seeing the shooters reloading.

"No one dared venture within the line of devastation. The hogs had been penned up in due time, the picking up of the dead and wounded being left for the next morning's employment. The pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. The uproar continued the whole night, and as I was anxious to know to what

distance the sound reached, I sent off a man accustomed to perambulate the forest, who, returning two hours afterwards, informed me he had heard it distinctly when three miles from the spot. Toward the approach of day, the noise in some measure subsided; long before objects were distinguishable, the pigeons began to move off in a direction quite different from that in which they had arrived the evening before, and at sunrise all that were able to fly had disappeared. The howlings of the wolves now reached our ears, and the foxes, lynxes, cougars, bears, raccoons, opossums, and polecats were seen sneaking off, whilst eagles and hawks of different species, accompanied by a crowd of vultures, came to supplant them, and enjoy their share of the spoil.

"It was then that the authors of all this devastation began their entry amongst the dead, the dying, and the mangled. The pigeons were picked up and piled in heaps, until each had as many as he could possibly dispose of, when the hogs were let loose to feed on the remainder.

"Persons unacquainted with these birds might naturally conclude that such dreadful havoc would soon put an end to the species. But I have satisfied myself, by long observation, that nothing but the gradual diminution of our forests can accomplish their decrease, as they not unfrequently quadruple their number yearly, and always at least double it. In 1805 I saw schooners, loaded in bulk with pigeons caught up the Hudson River, coming in to the wharf at New York, when the birds sold for a cent apiece. I knew a man in Pennsylvania who caught and killed upward of 500 dozens or more at a single haul. In the month of March, 1830, they were so abundant in the markets of New York, that piles of them met the eye in every direction. I have seen the negroes at the United States salines, or salt works, of Shawneetown, wearied with killing pigeons, as they alighted to drink the water issuing from the leading pipes, for weeks at a

time; and yet, in 1826, in Louisiana, I saw congregated flocks of these birds as numerous as ever I had seen them before, during a residence of nearly thirty years in the United States."

Nearly all of the birds which reside in or regularly migrate to North America are on exhibition, as well as large numbers of South American varieties. One entire case is devoted to the dainty, beautifully colored hummingbirds. Among the many striking species shown from Australia, New Zealand, and the South Sea Islands, perhaps the best known and most beautiful are the birds-of-paradise and the lyre-birds. Among the parrots is a New Zealand specimen which since the introduction of sheep raising in that country has taken up a horrid habit of prey. Alighting on the back of a poor sheep struggling through the snow, the gaudy-colored bird digs with its sharp curved beak quite down through the warm flesh until it reaches the kidney. This it pulls away as a dainty morsel, leaving the victim to its slow death.

Many birds native to Africa are on exhibition, among them being a family group of ostriches. The gorgeous Argus pheasants appear among the Oriental birds, and Europe and Northern Asia are represented by a large number of interesting species including the nightingale, the cuckoo, and the English robin. It is impossible to convey in a few words the wonderful profusion of bird life displayed in the halls of the Museum, from little drab-colored birds to the large gorgeous-hued parrot tribe of the tropics; from the tiny hummingbirds, smaller than a large insect, to the great eagles, with a wing spread of several feet. The variety in form, size, and color among these "feathered animals" affords much pleasure and wonder to visitors.

Of equal variety and perhaps even more vivid coloring are the tropical fishes, which are displayed in the hall devoted to fishes, reptiles, and amphibians. Strangest among the fishes are the curious creatures from the depths

of the sea, where they live beyond the penetration of sounds or sunlight from the upper world. The exhibits of reptiles and fishes are of necessity nearly all casts prepared from freshly killed specimens, painted in exact imitation of the living creatures. The reptiles include the alligators, crocodiles, and turtles, and a great variety of the snakes of America and foreign lands, among them the deadly cobra of India, and the great boa-constrictors and pythons.

The world has been racked about for ages by powerful forces. Time after time surfaces have been planed off to gentle slopes by wind and rain, frost and ice, rivers and oceans. Then new distortions have tilted them, new deposits of mud have covered them, new horizons have been planed down. So the cycles have gone their rounds until, if we should be able now to dig a great hole, miles deep, and examine at our leisure the strata on its sides, we should find some of them horizontal, and others inclining at angles even as great as 90°. In some instances we might find that great foldings had turned the strata bottom up.

Fortunately we do not need to dig great holes to reveal the story of the earth. Mountains upturn the strata, rivers cut down through them, and so, as for instance in the Appalachians of New York, a series of older and older horizons 80,000 feet thick is laid bare for inspection. Animals and their tracks were occasionally covered in the course of such processes, and now these fossil witnesses of ancient life are found illustrating the stone books of knowledge.

As we enter the great halls of the National Museum devoted to geology and paleontology, we note at our left a glass-covered case, 120 feet long, which summarizes the fossil story. On this large scale, the modern age during which man and the higher mammals have left their imprint occupies but a single foot. Even so, the scale is too short to represent the whole history of terrestrial

PLATE 8

Australian man, with boomerang, and wearing apron made of kangaroo skin, National Museum. Classed among the lowest races of man

PLATE 9

View of the Herbert Ward African collection, National Museum. The sculptures are the work of Mr. Ward

life. For the series begins with the Cambrian epoch, and it is now conceded that life existed at least as long before as since that era began.

Only the smaller types of fossils are to be found in this time-scale case, but the forms of the larger ones are indicated by pictures. To see these remains of the monsters of ancient days, however, we have but to turn aside to cases all about us or upon the walls.

Among the most popular paleontological exhibits are the fossil reptiles and mammals. Among the dinosaurs, or "terrible lizards," are the gigantic *Triceratops*, with its three horns, and the *Stegosaurus*, a formidable beast with large plates rising high above his back which served as armor. These are fossil skeletons which have been quarried from rock formations and set up in the Museum by skilled paleontologists according to the best information as to the habits and structure of these extinct animals. Models of some of them as they are believed to have appeared in life are also shown. Other fossil reptiles are the flesh-eating *Ceratosaurus* and the peculiar *Trachodon*, a dinosaur which stood erect on its hind legs. A number of large fossil mammals and birds are included in the exhibit, besides numerous smaller fossil forms of mammals, fishes, and reptiles. Other halls nearby are devoted to the less spectacular, though equally important, fossil invertebrate animals, to the interesting fossil plant forms, including the famous "petrified wood" from the Fossil Forest of Arizona and specimens of the ancient tree ferns.

In the section devoted to physical and chemical geology are the more common rocks and minerals which form the earth's crust, and exhibits arranged to show how rocks change. The grinding, planing, and scratching by glaciers; the products of volcanic action; cave formation; faults, folds, rock weathering, and soil formation are portrayed. Among the more interesting exhibits in this section is the large collection of meteorites acquired from many differ-

ent parts of the world. These celestial visitors coming from outer space are sometimes many tons in weight and contain iron, nickel, and many of the chemical elements which make up our earth. They include no chemicals which do not exist terrestrially. It has even been said that if enough meteorites could be collected to remake our world, its composition would not be very different from what it is.

Other halls contain the exhibits illustrating economic geology, including the ores of the more common metals such as gold, silver, copper, iron, lead, nickel, and zinc, as well as those of the rarer metals, tungsten, vanadium, and molybdenum, which now serve many practical uses. An important exhibit is that of a great variety of stones used in building and in ornamental work. Other economic exhibits relate to petroleum, coal, asphalt, fertilizer, abrasives, lime, and many other commercial products. Very beautiful is the series of minerals, gems, and precious stones arranged systematically in a separate hall. These specimens include the Roebling, Canfield, and Isaac Lea collections which form distinct exhibits and attract great attention from visitors. A unique accession to this section is a crystal ball thirteen and one-half inches in diameter, claimed to be the largest in the world. After this crystal was quarried, it required a year to grind it to a spherical form and six months to polish it to its present perfect condition. There is not a flaw or a sizable bubble in the sphere, this rare degree of perfection causing it to be valued at many thousands of dollars.

The crystal globe stands in the center of the Roebling specimens of fine minerals and gems. Col. Washington A. Roebling was a remarkable character. He was the son of the great bridge engineer, John A. Roebling, celebrated for successfully bridging the Allegheny and Monongahela Rivers, the Niagara chasm, and the Ohio at Cincinnati with suspension bridges. Undertaking the

still greater feat of spanning the East River from New York to Brooklyn, he was struck down before construction began by an accident while reconnoitering the site, and died at sixty-three years of age in July, 1869, leaving it to his son, Col. W. A. Roebling, to carry on. The latter had served with distinction in the Union Army during the Civil War. Enlisting as a private of artillery, he rose rapidly to great responsibilities in engineering and staff duty. He bridged the Rappahannock and the Shenandoah Rivers, discovered General Lee's northward march into Pennsylvania by balloon reconnaissance, took brilliant part in the battle of Gettysburg, and served with great valor on the staff of General Warren throughout the bloody campaign that began at the Wilderness and ended at Petersburg.

Colonel Roebling carried out his father's barely indicated plans for the Brooklyn Bridge with zeal and skill. In his complete devotion he sacrificed health for the remainder of his life, being struck down in 1872, early in the construction, by caisson disease owing to too continuous work in the underwater chambers. Though confined to his bed, he worked out in minute detail the plans and directions involved, and continued to direct the construction till the East River Bridge was successfully completed in the year 1883.

During Colonel Roebling's invalidism, he became more and more interested in the collection of minerals. He continued this avocation quite until his death in 1926, at the age of nearly ninety years. Even to his last days he loved to examine the specimens, which though they numbered many thousands and were with difficulty accommodated even in his large mansion, he knew as though they were children.

After many years of retirement, Colonel Roebling at eighty-four years of age accepted for the second time the presidency of the Roebling steel works at Trenton, New Jersey. With the progressive spirit of a young man, he

made radical improvements, accepted contracts involving millions, and strongly guided the affairs of the company into an era of special prosperity. He continued in active charge until his death.

Colonel Roebling's collection of minerals included specimens of almost every known variety. He was particularly desirous to make it as complete as possible, not caring so greatly for showy gems, although he had a few that were superb. He bequeathed the entire collection to his son, Mr. John A. Roebling, who, desiring to place it in a position of greatest usefulness, gave it to the Smithsonian Institution, together with an endowment of $150,000 for the purpose of adequately preserving, exhibiting, and amplifying this rare mineralogical cabinet.

About the same time, the Institution received the bequest of the large mineralogical collection of the late Dr. Frederick Canfield, together with an endowment of $50,000 for its preservation and care. The Roebling and Canfield gifts added to the already great mineralogical collections of the National Museum, which include the Isaac Lea collection of gems, make altogether perhaps the greatest assemblage of well-chosen mineralogical specimens in the world.

The ground floor of the Natural History Building contains, besides lecture rooms and special exhibits, a well-designed auditorium seating several hundred people, which is used not only by the Institution and its branches, but also by numerous scientific and other societies and organizations for lectures, meetings, and conferences.

It is for lack of adequate buildings to contain the ever-increasing public treasures of a great nation that it became necessary to exhibit in the rotunda and in the foyer leading to the assembly hall of the Natural History Building a great many objects illustrating the equipment and operations of the Army and Navy in World War I. Among these were found, for instance, the searchlights in which the inventive genius and engineering driving power

PLATE 10

Unique human figure designs on pottery collected from Indian mounds in Arkansas, now in the National Museum

of America made a quick revolution during the brief months after the intervention of the United States. Indeed it was a report summarizing the war investigations of the Smithsonian Astrophysical Observatory in this line that aided Captain Lewis to make an improvement which cut down the weight and cost and increased the efficiency of field searchlight equipment severalfold. These and other improvements being embodied by the General Electric and the Sperry Companies in actual production, new model searchlights of greatly increased power and mobility reached the forces in France before the armistice.

The older Arts and Industries Building is at present devoted to the exhibits of the divisions of history, engineering, crafts and industries, and medicine and public health. The crafts and industries division includes the sections of textiles, wood technology, chemical industries, and agricultural industries. The history exhibits contain mementos of famous men and events of American history, including uniforms, swords, guns, personal effects, flags, and many other interesting relics. The most popular exhibit in this division, indeed one of the most popular in the whole Museum, is the collection of costumes worn by the Presidents' wives from the time of George Washington to the present day. These are shown on plaster models, arranged chronologically. No attempt is made to represent the features of the ladies who wore the dresses, for classic forms are used which are representative only as to general proportions. The costumes, however, form the most comprehensive and accurate series in existence of the styles which have prevailed in ladies' dresses since the birth of America. Great contrasts force themselves upon us, as between the wide expanse of the ground-touching skirts of 1840 and 1860 and the severe spareness of the short skirt of 1925; and as between the profuse decoration and overskirt of 1880 and the almost perfect plainness of the skirts of 1900 or 1910. Not less striking is the change of hair-

dress, which ranges from the utmost simplicity at certain periods, through waves, to long curls about the neck, and to great rolls heaped high above the head. But however differently clothed and coiffured these counterparts of the White House ladies may appear, they are, with few exceptions, quite as charming in their individual appearance as in their variety.

The mechanical collections in the Arts and Industries Building illustrate the early stages and development of the great inventions, among them the locomotive, the internal-combustion engine, the telegraph, telephone, and radio, the automobile, the airplane, and many other devices characteristic of this "mechanical age."

Here we see the earliest telephones made by Alexander Graham Bell's own hands. As we look upon them we seem to catch the thrill of the first spoken message ever transmitted by electromagnetism: "Come here, Watson, I want you"; and we try to imagine the world of today deprived of the telephone. Here, too, are the beginnings of Edison's incandescent lamp and phonograph. As we look upon them we think back to the world of the firelight, the candle, and the oil lamp, by which the great poets and writers of former centuries wrote imperishable things. We remember with regret that the voices of the golden-mouthed Chrysostom, the large-hearted Lincoln, the great actors Garrick and Salvini, and the lovely songs of Malibran and Jenny Lind passed away irrevocably before the time of inventions which could have preserved them forever.

In this building are exhibited also series of guns, watches, boat models from the primitive native canoe to the modern ocean greyhound—in fact, everything of mechanical origin. The mineral-technology series illustrates, by means of large-sized detailed models the various industrial processes such as coal mining, salt mining, glass making, plaster manufacturing, and many other essential industries.

The section of textiles displays examples of the most varied and beautiful silks, cloths, fabrics, laces, tapestries, and other products of the textile art; also early machinery used in weaving and spinning. The division of medicine shows series of medicines and the materials used in their fabrication, as well as a large amount of interesting historical material relating to the early days and the later development of medical science. The wood-technology exhibits illustrate the uses of many varieties of wood, both American and foreign, while the section of chemical industries, in addition to products of modern synthetic chemistry such as plastics, lacquers, etc., includes a collection of chemical types, which is of the greatest value to students and research workers.

Another section added since World War I is that devoted to aircraft, which are housed in a large metal building near the Arts and Industries Building. Here are shown a large assortment of aircraft ranging in size from tiny scout monoplanes to the giant Martin bombers which carry, besides the bombs themselves, a crew of several men. Famous planes are exhibited: we find Lilienthal's glider; Langley's large models which pioneered the air in 1896, though unmanned; the Wright plane purchased for the Army in 1908, which was the first military plane of any nation; the NC-4 the first airplane to cross the Atlantic under its own power; and the *Chicago*, flagship of the aerial squadron which first circumnavigated the world. Attracting more attention than any of these, or indeed than any Museum exhibit, is Colonel Lindbergh's *Spirit of St. Louis* deposited in the Museum in May, 1928, by its daring and modest pilot. This machine is exhibited with the following label:

THE SPIRIT OF ST. LOUIS
IN WHICH
COL. CHARLES A. LINDBERGH
ALONE MADE THE
FIRST NON-STOP FLIGHT, NEW YORK TO PARIS

This flight by Colonel Lindbergh, a graduate of the United States Army Aviation School, an air mail pilot, won the Raymond Orteig $25,000 prize.

Flight began May 20, 1927, at 6:52 a.m.; passed Newfoundland about one hour before sunset; through fog, wind, rain, and sleet over Atlantic all night; sighted Ireland in afternoon about 3 miles from course; landed at Le Bourget Airport, Paris, 4:20 United States Eastern standard time, May 21. Elapsed time 33 hours, 28 minutes. Travel 3,610 miles. Colonel Lindbergh received princely acclamations in France, Belgium, and England, and returning by warship, found his native country at his feet.

The *Spirit of St. Louis* was constructed to Colonel Lindbergh's order by the Ryan Airlines Inc., of San Diego, California, and financed by the following group of his St. Louis friends:

Mr. Harry H. Knight
Maj. William B. Robertson
Mr. Harold M. Bixby
Mr. Earl C. Thompson
Maj. Albert Bond Lambert
Lieut. Frank H. Robertson
Mr. Harry F. Knight
Mr. J. D. Wooster Lambert
Mr. E. Lansing Ray

Made in 60 days, the plane was flown from San Diego to New York by Colonel Lindbergh with one stop at St. Louis, breaking all cross-continental records, in 21 hours, 22 minutes.

July 20, 1927, to October 23, 1927, Colonel Lindbergh flew in the *Spirit of St. Louis* into every state of the Union, and spoke in 72 cities under the auspices of the Guggenheim Fund for the Promotion of Aeronautics, urging municipal airports. Journey covered 22,350 miles, only once missed appointment, owing to fog, and ended 1 minute before schedule time.

December 13, 14, 1927, Colonel Lindbergh in the *Spirit of St. Louis* made a non-stop flight from Washington to Mexico City, thence to the capitals of Central America, Venezuela, Colombia, West Indies, and Cuba, and then to St. Louis, Missouri, covering 9,200 miles; everywhere acclaimed as Ambassador of Good Will.

The *Spirit of St. Louis* has a span of 46 feet, chord of 7 feet, and uses the Clark-Y wing section. Its length is 27 feet, 3 inches. It is powered with a Wright "Whirlwind" J-5-C radial air-cooled engine developing 223 horse power, at 1,800 revolutions a minute. The fuel capacity is 451 gallons of gasoline and 28 gallons of oil. The economical cruising speed full load is 97 miles an hour; high speed, 128 miles an hour; weight, empty, 2,150 lbs.; loaded, 5,250 lbs.

PLATE 11

The "Spirit of St. Louis" as it hangs at the main entrance of the Arts and Industries Building, National Museum. After safely covering over 42,000 miles with the other partner of "We," Col. Lindbergh deposited the plane in the Museum where it attracts thousands of visitors daily

Flights of the Spirit of St. Louis

Test flights at San Diego
San Diego to St. Louis
St. Louis to New York
New York to Paris
Paris to Brussels
Brussels to London
London to Gosport. (On Flagship Memphis, Gosport to Cherbourg to Washington)
Washington to New York

New York to St. Louis
St. Louis to Detroit to Ottawa
Ottawa to New York
Tour of 48 States ending at New York
New York to Washington
Washington to Mexico to Central America to South America to West Indies to St. Louis
St. Louis to Washington

DEPOSITED BY COLONEL CHARLES A. LINDBERGH

The National Museum now requires three large buildings covering many acres of floor space, and is still increasing at the rate of several hundred thousand specimens each year. It is estimated that the collections, on exhibition and in the study series, contain well over seventeen and a half million individual specimens.

The present Assistant Secretary of the Smithsonian Institution, in charge of the National Museum, is Dr. Alexander Wetmore. Doctor Wetmore served for fourteen years in the Biological Survey of the U. S. Department of Agriculture, where he conducted numerous investigations dealing with birds and mammals. He is best known for his ornithological researches, and he has published many scientific papers on birds. In 1923 Doctor Wetmore directed the U. S. S. *Tanager* expedition, which engaged in general scientific exploration of islands in the Pacific and he has since then engaged in numerous field expeditions, particularly to South and Central America.

CHAPTER III

HOW THE NATIONAL MUSEUM ORIGINATED

It was James Smithson's own collection of choice gems and minerals that formed the nucleus of the National Museum. Besides the Smithson minerals, there were many other objects of historical interest, or of natural history and geological value, which had come into the possession of the Government but lacked appropriate quarters for their preservation and exhibition. Accordingly the Act of 1846, which established the Smithsonian Institution, provided that "in proportion as suitable arrangements can be made for their reception, all objects of art and of foreign and curious research, and all objects of natural history, plants, and geological and mineralogical specimens belonging, or hereafter to belong, to the United States, which may be in the City of Washington, in whosesoever custody the same may be, shall be delivered to such persons as may be authorized by the Board of Regents to receive them, and shall be arranged in such order and so classed as best to facilitate the examination and study of them, in the building so as aforesaid to be erected for the Institution."

The National Institute, a short-lived forerunner of the Smithsonian, had acquired the large collections brought back by the U. S. Exploring Expedition sent out in 1838 by the Navy Department in charge of Lieutenant Wilkes. This was a remarkable expedition in charge of an extraordinary man. The expedition of six ships sailed from Hampton Roads in 1838, visited Tierra del Fuego, Chile, Peru, the Paumoto and Samoan Islands, and Aus-

tralia; then sailed south in December, 1839, into the Antarctic. It reported an Antarctic continent discovered west of the Balleny Islands, visited the Fiji and Hawaiian Islands, explored the west coast of the United States, and returning by way of the Sulu and Philippine Islands, Borneo, Singapore, and the islands of the Pacific, doubled the Cape of Good Hope, and reached New York in June, 1842.

Wilkes was almost immediately court-martialed on various charges including false report of the discovery of the Antarctic Continent, but acquitted of all except that of inflicting illegal punishments on his men. Wilkes Land, discovered in January, 1840, was accepted somewhat doubtfully by geographers until corroborated by Sir Ernest Shackleton in 1908. The results of the expedition were published by the Government as prepared by Wilkes, Dana, and others in nineteen volumes containing much of great interest about these then little-known regions.

During the Civil War, Wilkes commanded the U. S. ship *San Jacinto* at the time of the search of the British ship *Trent* and the capture of Mason and Slidell, Confederate Commissioners. Wilkes was officially thanked by Congress, but President Lincoln averted war with Great Britain over the incident by disavowing the act and restoring the captured envoys. Engaging somewhat later in a controversy with Gideon Welles, Secretary of the Navy, Wilkes was again court-martialed, found guilty, publicly reprimanded, and suspended for three years. But in July, 1866, he was promoted to the rank of rear admiral and retired. He died at the age of seventy-nine years in 1877.

Besides the Wilkes collections, other material was rapidly added, and this embryo museum of the National Institute attracted wide interest, thus educating popular opinion in the way of considering a National Museum as a proper activity for the Government. Through various

causes the fortunes of the National Institute declined after the establishment of the Smithsonian, and in 1861 it was dissolved and all of its considerable natural history and other collections were turned over to the Smithsonian.

In 1850, Baird, an enthusiastic naturalist of twenty-seven years of age, came to the Smithsonian as Assistant Secretary in charge of the Museum and the publications, and from this date began the rapid growth of the National Museum. Baird brought to Washington with him his private collection of birds and other zoological specimens, which was large enough to fill two freight cars. He was a born collector, and began as a boy only fourteen years old to collect, with his brother William, the birds and other specimens found near his home at Carlisle, Pennsylvania. Valuable as was the Baird collection, still more valuable to the Museum were the methods of caring for it which Baird had developed in his own little museum at Carlisle. The system of sorting, arranging, and recording collections which he had used there proved to be so elastic that it was applied with marked success to the much more extensive collections which were rapidly acquired by the National Museum.

A frequent occurrence at the Museum, and an excellent test of the recording system in operation, is a request by a visitor to see objects given to the Museum by his father twenty-five or thirty years ago. Often the visitor may not know even what the objects were. The name is first located by the office of correspondence and documents in the card index of all accessions, and on the card appears the accession number that is given to each object received, as well as a catalogue number assigned in the division of the Museum to which the objects were sent. Upon pursuing the matter further, the visitor finds in the office of the curator of the proper division another card file, and upon the card bearing his father's name will appear the complete history of the specimens—their kind, classi-

fication, when received, where found, and all other pertinent information, as well as the location in the Museum of the specimens themselves. The visitor is then taken directly to the specimens, and may examine them himself. All correspondence, accession forms, and other papers relating to each separate accession are stamped with the same number, and are preserved permanently in the Museum's files. The catalogue number of each individual object is kept in a catalogue book and this number is also attached to the object itself by means of a tag or label.

The great number of expeditions, Government and otherwise, going out for the purpose of locating railroad routes and surveying boundaries in the West during the period beginning in 1850, afforded an unprecedented opportunity to secure natural history material, and Baird made the most of it. He used the influence of the Smithsonian to obtain the cooperation of the departments of the Government in charge of the explorations, and Army officers, surgeons, naturalists, and others accompanying the surveys were instructed as to what was wanted and how to secure it.

Baird even gave return out of his private time on some occasions, as when he agreed to see a manual of bayonet exercises through the press in Philadelphia for Captain, afterwards Major-General, George B. McClellan, then stationed in Texas. This is mentioned in the following letter from Baird to McClellan, which shows how well he was seconded by the young officers in the field in his efforts to preserve specimens of the fauna and flora of our western frontiers:

"Washington, November 6th, 1852.

"My dear Captain:

"It was with the greatest pleasure that I received your letter of August 12, 1852, forwarded by Capt. Marcy a week ago from New York. Accompanying it was a note

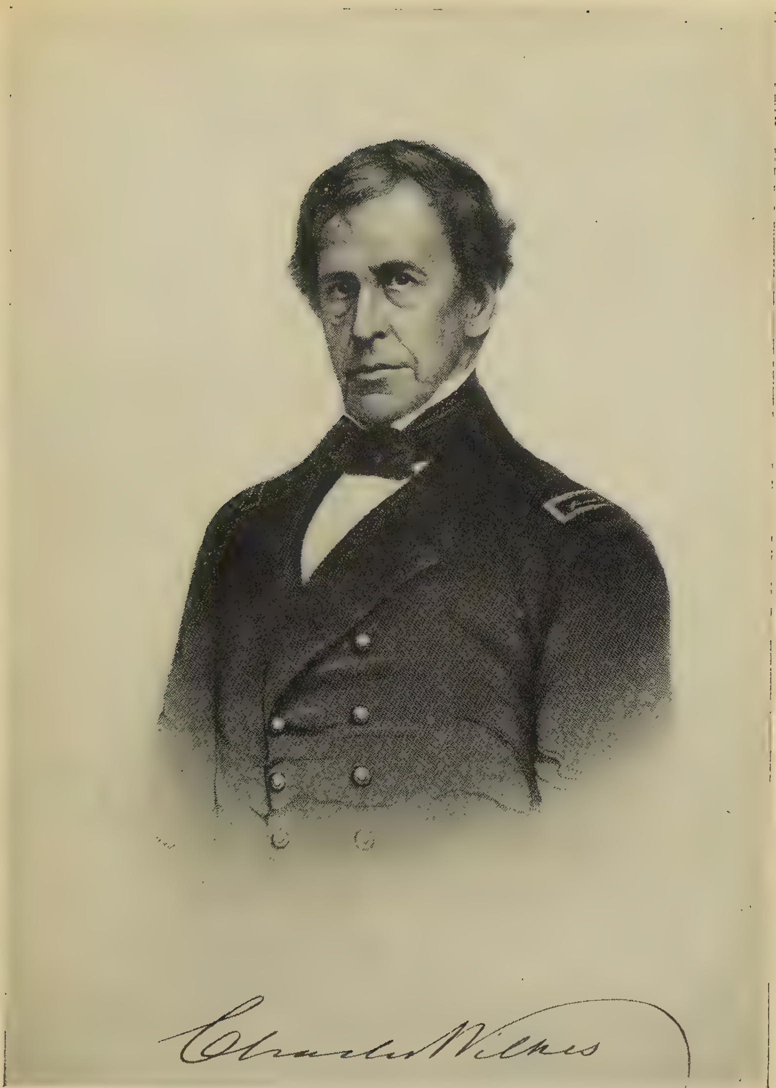
from him stating that he had hoped to bring it in person, but sickness detained him in New York. The specimens themselves arrived about the same time, and I must confess to a little astonishment at the amount and value of the collection. I am so much accustomed to have promises made with little or no result that, although feeling assured that you would keep yours, I was entirely unprepared for what you have done. Everything arrived in most capital order, and although the delay in receiving some jars ordered has prevented my arranging the specimens for a careful examination, I still see great promise of scientific novelty. The fishes are especially interesting, and the whole collection enables me to fill up a great gap in the Zoological geography of the country. It will afford me the greatest pleasure to furnish an appendix to the Captain's report on these, to be illustrated by figures of new species. When I see him, I can learn more fully his views on this subject.

"Inside of the box, and outside of the cans, came a skin of *Bassaris astuta*, or Civet Cat. Where was this found? Its locality must be further North than any other yet given. The Rio Grande has been its limit previously.

"I was much indebted to you also for the account of the route in your letter. It is just what I wanted for my report on scientific explorations to the Regents of the Smithsonian. I have received a similar one from Capt. Sitgreaves of his Zuñi trip.

"The 'Bayonet Exercise' takes well, and is considered quite a standard of printing. Col. Freeman told me that he had sent you one. If you have not received it, let me know. I copyrighted it, as you desired. Lippincott has not yet published an edition, but wants to ascertain the demand. The entire cost of the 2,000 copies was about $800.00. Write soon and often and thereby increase the obligation under which labors,

"Yours sincerely,
(Signed) "S. F. Baird.



Lieutenant Charles Wilkes, leader of the U. S. Navy's exploring expedition around the world 1838–1842

PLATE 13

George Brown Goode, Assistant Secretary of the Smithsonian Institution, in charge of the National Museum from 1887 to 1896

"P. S. I wrote to Dr. Shumard at the suggestion of his brother, offering my services in having his collections elaborated for publication, but have received no reply. When Capt. Marcy comes on, I will endeavor to inoculate him with the Nat. Hist. virus, and if I have as good fortune as with you, shall be well satisfied. He can do much for us, and I trust will feel so much inspirited by the results of his last trip, as to continue the operation ever after.

"In speaking of your collections before, I forgot to say that your wishes in regard to the Academy shall be faithfully attended to. . . .

"A thousand thanks for your kind promise to make additional collections in Texas. I need not say that I want *everything*. Corpus Christi, if you are there, is a most important point. You are so successful in alcoholic collections, that I hope you will continue these. Gather *all* kinds of fishes and reptiles, of the former especially the small fry. Skins and skulls of all kinds of quadrupeds, big and little. Any bird skins or eggs, shells, crabs, and the like. Look out for fossil bones. Do you know Capt. Van Vliet, at Ft. Brown? He is a capital fellow and has been a very kind friend of mine."

The Smithsonian offered every possible facility for the work of volunteer collectors, including outfits and instructions, and within a short time the new National Museum began to reap a rich harvest, so that in 1853, three years after his arrival at the Institution, Baird reported:

"It may be well to call attention to the fact that it has been the work of but three years to raise this collection from nothing to the front rank among American cabinets, exceeding all perhaps in the number of new species first brought to light within its limits."

The flood of natural history material coming in from the surveys of the West, at that time almost unknown from a scientific point of view, continued, and after ten years Secretary Henry wrote regarding the Museum:

"The scientific material thus collected is very valuable, and, in number and variety of specimens and duplicates to illustrate the natural productions of the North American Continent, far excels any other collection ever made."

These collections, which included many new forms of mammals, birds, reptiles, and fishes, were not allowed to lie idle and useless in the Museum, but according to a plan carefully worked out by Henry and Baird, they were classified and described by recognized authorities in the various branches of natural history throughout the country. To show what advance this brought about in the biological sciences, Baird stated after the work had proceeded only a few years:

"Messrs. Audubon and Bachman describe about 150 North American species of mammals. This Institution possesses about 130 of these; and about fifty additional species have already been detected, although the examination of the entire collection has not yet been completed.

"Of North American birds, the Institution possesses nearly all described by Audubon, and at least 150 additional species.

"Of reptiles, the North American species in the Museum of the Smithsonian Institution amount to between 350 and 400. Of the 150 species described in Holbrook's 'North American Herpetology,' the latest authority on the subject, it possesses every genuine species, with one or two exceptions, and at least 200 additional ones.

"Of the number of species of North American fishes it is impossible to form even an approximate estimate, the increase having been so great. It will not, however, be too much to say that the Institution has between four and five hundred species either entirely new or else described first from its shelves."

In 1865 the Smithsonian building was visited by a disastrous fire which completely burned out the second floor. Although several important individual groups

of objects were destroyed, fortunately the flames did not reach the main body of the collections. The chief losses included the books, manuscripts, and personal effects of James Smithson, and his excellent cabinet of minerals described above, which was the first collection of scientific material owned by the United States Government. Of the Stanley Indian paintings, all were lost but five. Among other losses was a small collection of apparatus and instruments used in researches in physics, including the lens of Priestley, who first recognized the existence of oxygen as a distinct element. The destruction of the Stanley paintings, together with Secretary Henry's feeling that the funds available for the formation of an art collection were entirely inadequate, led to the transfer of the few remaining works of art at the Institution to the Corcoran Art Gallery and to the Library of Congress, and the art feature of the Institution thereafter lay dormant for many years, until revived by the bequest of Harriet Lane Johnston, and the reestablishment of the National Gallery (now the National Collection of Fine Arts) in the year 1906.

With the establishment of the Fish Commission in 1871, the collections of marine forms in the Museum received a great stimulus. As the inception of the idea was to a great extent his own, and as no one in the country was equally competent to undertake the new project, Professor Baird, at that time Assistant Secretary of the Smithsonian, was placed at the head of the Commission. He continued to serve as Commissioner of Fisheries until his death in 1887, and, at his own insistence, wholly without compensation. Thus was effected a close cooperation between the Smithsonian and the Fisheries which has continued to the present day. Beginning with the study of the life in the waters along the coasts, the work of the Commission was gradually extended to include deep-sea investigations, culminating in the construction and operation of the *Albatross*, a steamer of sufficient size to conduct deep-sea dredging operations. The col-

lections of marine life brought together through these researches were deposited in the Museum, where they were studied by members of the staff, and the results were published by the Institution.

With the year 1876 ended the first century of the independence of the United States. At the city of Philadelphia, where the Declaration of Independence was signed on July 4, 1776, America's first international exposition was held to commemorate the event. Foreign nations, even to far-off Siam, sent copiously of their products, inventions, and manufactures to add to the display. It was there that Dom Pedro, Emperor of Brazil, was struck by the astounding invention of the telephone, which was being exhibited by Alexander Graham Bell, who later served the Smithsonian for many years as a Regent.

The Centennial Exhibition proved to be another powerful stimulus to the growth of the National Museum. In addition to the valuable and comprehensive exhibits prepared by the departments of the Government, which were all turned over to the Smithsonian at the close of the Centennial, exhibits of scientific material were also presented by numerous foreign governments. Regarding these last, Professor Baird wrote:

"With scarcely an exception, the best and most important of these were presented to the United States at the close of the exhibition, embracing, as they did, many complete series of objects illustrating the geology, metallurgy, the ethnology, and the general resources of all nations. Of about forty governments and colonies, the choicest of the exhibits of thirty-four were presented to the Smithsonian Institution for the National Museum, the remainder either having nothing to give or being restricted in the disposal of their articles.

"It was, however, not from foreign commissions alone that collections were received by the Institution. Several entire State exhibits and many belonging to private parties were also added to the general increase. Nevada,

Montana, and Utah presented the whole of their mineral exhibits, while partial collections were received from several other States and Territories."

These collections taxed the capacity of the already overcrowded Smithsonian building to the utmost, and this same year, 1876, the Regents petitioned Congress for a separate building for the National Museum. After three years, this request was approved, and the building was begun in 1879. It is now called the Arts and Industries Building. Since its completion in 1881, this building has sometimes been criticized for its appearance, but it must be remembered that with the mass of valuable material to be accommodated, it was necessary to provide as large a floor space as possible, and that the Congressional appropriation for the building was only $250,000. Covering, as it does, a space of two and one-third acres, it is undoubtedly the cheapest permanent building of its size ever erected. Its average cost per cubic foot was only six cents! Before the collections were moved into it, this building was used on March 4, 1881, for the inaugural reception of President Garfield. With the new building available, Dr. G. Brown Goode, then Curator of the Museum, reorganized the whole collection and method of administration, producing "a public museum of wide scope, attractive, orderly, and full of the elements of life."

The collections of the National Museum continued to increase rapidly in the succeeding years, particularly after the passage in 1880 of an Act of Congress providing that "all collections of rocks, minerals, soils, fossils, and objects of natural history, archeology, and ethnology, made by the Coast and Interior Survey, the Geological Survey, or by any other parties for the Government of the United States, when no longer needed for investigations in progress, shall be deposited in the National Museum."

As the nineteenth century drew to a close, the necessity for additional space again became a pressing matter, the

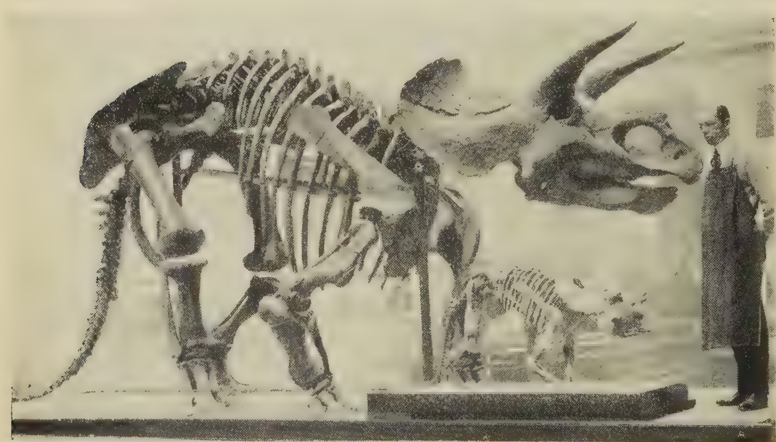
halls of the Museum building being again filled to overflowing. The need of another and larger building particularly for the exhibition of natural history material was urged by the Regents. After several years, Congress acted favorably in the matter, and this time a building more suitable for the museum work and more harmonious with the beauty of the National Capital was projected. Constructed of white granite and planned in every detail according to the most advanced ideas on museum construction, the new Natural History Building is not excelled by any museum building in the world. It was finally completed and opened to the public in 1909, and the older building was thereafter devoted to exhibits pertaining to the arts and industries and American history. The original Smithsonian building, which until 1879 housed the entire collections of the National Museum, now contains the exhibits of only one division of the arts and industries department—that of graphic arts.

PLATE 14

The kea, a sheep-eating parrot. The bird sinks its sharp bill through the flesh to get at the kidney, its preferred food, and leaves the victim to die

PLATE 15

A—How the *Triceratops* looked in its native haunts millions of years ago. Its skull sometimes reached a length of eight feet. Painting by Charles R. Knight



B—Skeletons of *Triceratops* and *Brachyceratops* in the National Museum, the largest and smallest of the extinct reptiles known as horned dinosaurs

CHAPTER IV

RESERVOIRS AND STREAMS OF KNOWLEDGE

It is said that there was once a prince who was distressed when he ascended the throne to see that his people were unhappy. The poor envied the rich, and the rich disdained the poor. Still they had this in common: both alike were bored by the emptiness of their minds.

These sad conditions were the more surprising to the good prince because there had been in that country, time out of mind, a university endowed to teach happiness. Reflecting upon the failure of this famous institution to bring about universal happiness, the prince concluded that perhaps the course of instruction was too costly and too elaborate. He conceived the plan of having its essential elements printed in a brief form and distributed broadcast over his dominions. He thereupon requested each of the hundred professors to write out the essence of his branch of the subject. They labored for a year's time and brought the result in one hundred volumes. As this was far too bulky for his purpose the prince instructed the professors to condense the matter into ten volumes. These again, upon completion, proved to be not sufficiently concise and simple to accomplish the prince's purpose among his subjects, and he finally requested the President of the University of Happiness to put the whole story into one single volume. Although the learned president felt that he would be sacrificing his reputation among scholars by attempting to compress the subject within this compass, and although he remonstrated with the prince, yet when the latter insisted he undertook the

superhuman task, which he accomplished in another year. He brought the volume with excuses to the prince, who, content at last, was about to issue the great work in millions of copies to insure the happiness of all his subjects. But as he lay upon his bed contemplating the benefits which ought to ensue, a great thought came to him. The whole subject of happiness could be reduced, so it seemed to him, to two words!

These magical words are short and easy in the language of that country, though more cumbersome in their English translation. They mean common sense and altruism. Some people, as the prince was aware, have common sense but without altruism; and a few have altruism without common sense. Many have neither the one nor the other. The prince perceived that by the universal practice of a judicious mixture of common sense and altruism all of his subjects would be happy; for the many would promote the happiness of the individual, without embarrassing him with unwished-for blessings forced on him with lack of common sense.

Doubtless the prince broadcast his discovery. Unfortunately, practice did not quite catch up with theory. Unhappiness was not wholly abolished. At least, however, the prince laid his thought at the root of one great cause of unhappiness, when he attributed it to the emptiness of people's minds. It is for curing this, quite as much as in its application to the ordinary utilities of knowledge, for food, shelter, clothing, and transportation, that the public benefit of James Smithson's bequest "for the increase and diffusion of knowledge among men" inheres. The present chapter describes three great methods used by the Smithsonian Institution for the diffusion of knowledge.

The Smithsonian Library

The Library of the Smithsonian Institution is not merely a vast assemblage of books on every subject under

the sun, nor is it specialized on any one subject. It is a working library for the use of students and investigators in every branch of science, and consists essentially of the transactions and memoirs of learned societies, technical and scientific periodicals, the journals of museums, academies, and institutions throughout the world, and the publications of governmental scientific organizations. A record of scientific achievement in all countries is thus brought together that forms one of the most complete and important sources of information for workers in every branch of science that exists in the world today.

Its library has always formed an important part of the Smithsonian Institution. Obviously a working library is a prime essential to an institution devoted to the encouragement of research and the advancement of knowledge. In the days before the character of the Smithsonian had been definitely decided upon by Congress, there were many who believed the surest way to fulfill James Smithson's wishes for an institution for the increase and diffusion of knowledge among men was to establish a great library, the Honorable Rufus Choate asking, "Does not the whole history of civilization concur to declare that a various and ample library is one of the surest, most constant, most permanent, and most economical instrumentalities to increase and diffuse knowledge?" Mr. Choate was the most persistent advocate of devoting the Smithson fund entirely to the upbuilding of a great library, and on many occasions during the eight years of Congressional debate on the nature of the new institution, he waxed eloquent on the subject of his preference. In 1845, only a year before the final passage of the Act establishing the Smithsonian, he declared:

"We cannot do a safer, surer, more unexceptionable thing with the income, or with a portion of the income —perhaps twenty thousand dollars a year for a few years —than to expend it in accumulating a grand and noble public library—one which, for variety, extent, and wealth,

shall be, and be confessed to be, equal to any now in the world."

The library idea received considerable support in both houses of Congress, and had a little additional influence been available, the Smithsonian might today be a great public library. Representative Robert Dale Owen of Indiana was one of the foremost opponents of the attempt to turn the Institution into a general library, urging the logical consideration that since James Smithson was himself a scientist, his obvious wish was for a scientific institution, and had be desired to found through his bequest a great library, he would have definitely said so in his will. The final provision relating to a library in the Act establishing the Smithsonian was a compromise between the two groups, and was worded thus:

"The said Regents shall make, from the interest of the said fund, an appropriation, not exceeding an average of twenty-five thousand dollars annually, for the gradual formation of a library, composed of valuable works pertaining to all departments of human knowledge."

Under the direction of Prof. Charles C. Jewett, probably the foremost bibliographer of America at that time, the Smithsonian library began to collect scientific books and periodicals. Professor Jewett also made a beginning of the formation of a catalogue of all American libraries, and in conjunction with this another plan was attempted—that of furnishing libraries with general catalogues printed from stereotype plates. This scheme was the forerunner of modern scientific bibliography, but unfortunately at the time it was not a success, owing to certain mechanical defects in the process devised by Professor Jewett. The reasons for the failure were thus described by Doctor Poole in 1886:

"The material he used [for the stereotype plates of titles for the general catalogue] was a sort of clay from Indiana. Congress made an appropriation for executing the plan. I recollect that the librarians of the country

generally favored it, and that I did not. I remember that I spoke of it at the time as 'Professor Jewett's *mud* catalogue.' My views concerning it were based on some practical knowledge of legitimate typography, and from specimens of the work which Professor Jewett exhibited. . . . It failed from mechanical defects in the process—the shrinking and warping of the blocks in baking, and the intractable nature of the material when baked, which made the exact adjustment of the blocks on the press impossible."

In 1865 the fire which destroyed the entire second story of the Smithsonian building called attention to the fact that the library, by that time of very considerable size and importance, although not damaged by the fire, was not in safe quarters; and Congress authorized the deposit of all of the Institution's books in the Library of Congress, although remaining under the control of the Institution. This was an important step, and today by far the largest part of the Smithsonian library is housed in the Library of Congress, where it is known as the Smithsonian deposit. The value of this arrangement was described in 1876 by Mr. Spofford, then Librarian of Congress, as follows:

"The union of the library of the Institution with that of Congress still continues to be productive of important results. The Smithson fund is relieved by this arrangement from the maintenance of a separate library, while at the same time the Institution has not only the free use of its own books, but also those of the Library of Congress. On the other hand, the collection of books owned by Congress would not be worthy the name of a National library were it not for the Smithsonian deposit. The books which it receives from this source are eminently those which exhibit the progress of the world in civilization, and are emphatically those essential to the contemporaneous advance of our country in the higher science of the day."

In 1887 Professor Langley, then Assistant Secretary of the Institution, inaugurated the plan of increasing the periodical scientific literature of the library by obtaining a complete list of all such periodicals and arranging with them for a system of exchange for the Smithsonian publications. This list reached the large total of 3,600, and a good proportion of these, representing many languages, have gradually been added to the regular receipts of the library. Regarding this practice, Dr. Cyrus Adler, then in charge of the library, wrote in 1896:

"The growth of its own library has been specially favored by the magnitude and value of the publications which it has had to offer in exchange, both those issued by Congress and those printed from its private fund. By means of its publications, and by means of its Exchange Service, the Smithsonian Institution has incidentally secured a library more valuable in actual amount and more unique in character than it could possibly have obtained had the plan of a library, pure and simple, so ardently advocated by Senator Choate, been carried out. Dr. G. Brown Goode, the Assistant Secretary of the Institution, estimated in 1895 that 'The value of the books distributed since the Institution was opened has been nearly $1,000,000, or nearly twice the original bequest of Smithson.' "

The Smithsonian library as now constituted is in reality a library system, for it is composed of ten distinct libraries, each an independent unit serving its own end in its own place. These ten divisions of the Smithsonian library have grown out of the various activities of the Institution in administration, research, and publishing. Chief among the divisions are, of course, the Smithsonian deposit in the Library of Congress, which is the main library of the Institution, and the library of the National Museum, which consists largely of material relating to the different branches of natural science represented in the Museum. The other divisions are: the office library,

Restoration of *Stegosaurus*, an extinct reptile, over fourteen feet long, modeled by C. W. Gilmore of the National Museum

PLATE 17

Preparator cutting fossil animal bones from their solid rock matrix

which is made up of the publications of some of the older and more important learned societies and academies, including those of London, Paris, Rome, Berlin, Halle, Vienna, and Leningrad, together with the art-room collection, the employees' library, and reference books; the technological library, which concerns itself chiefly with the useful arts and industries; the library of the Astrophysical Observatory, which contains works on astrophysics and meterology, and is of much value just now in connection with the well-known researches in solar radiation that are being carried on by the Institution; the library of the Bureau of American Ethnology, which consists almost exclusively of works on anthropology, particularly those having to do with the American aborigines, and covers especially the languages, history, archeology, myths, religion, arts, sociology, and general culture of the American Indian; the Langley aeronautical library, which was named after Samuel Pierpont Langley, the third Secretary of the Smithsonian, in recognition of his epoch-making contributions to the science of aeronautics; the library of the National Collection of Fine Arts, which is a small but carefully chosen collection of books and pamphlets on the fine arts of America and Europe; the library of the Freer Gallery of Art, which is restricted to the interests represented by the collections of objects pertaining to the arts and cultures of the Far East, India, Persia, and the Nearer East, by the life and works of James McNeill Whistler and of certain other American painters whose works are owned by the Gallery, and, further, to a very limited degree, by the Biblical manuscripts of the fourth and fifth centuries, which, as the possession of the Freer Gallery, are known as the Washington Manuscripts; and, finally, the library of the National Zoological Park, which is made up of publications on animals and other subjects of immediate concern to the Park.

These ten divisions, then, taken together, comprise the

Smithsonian library. But the largest and most venerable of all is the Smithsonian deposit in the Library of Congress. This was for many years the only library of the Institution; it is today, as has already been said, its main library. It ranks as the foremost collection of the memoirs and transactions of learned societies and institutions to be found in our country, just as the Smithsonian library as a whole, with its more than 800,000 volumes, pamphlets, and charts, to say nothing of its thousands upon thousands of volumes awaiting completion, ranks as the foremost collection of scientific publications in America, and perhaps in the world. The Smithsonian library, although composed of these ten more or less widely scattered and independent divisions, functions as a unit, since the activities of its main departments—accessions, catalogue, reference, and loan—center for the most part in the Smithsonian building. In this building, too, is kept the union catalogue, which, when completed, will be the key to the entire system.

This great collection of scientific and other material, although primarily a reference collection for the use of the research workers in the Institution and its branches, is freely available, not only to the student elsewhere in Washington, but also to the scholar outside, for the library lends its books to other libraries, especially those of universities, museums, and learned societies, throughout the country.

The original plan for the library has been followed in the main from the beginning to the present day, and its development was thus described some years ago by Dr. Cyrus Adler:

"It is thus manifest that the Smithsonian Institution, while not unmindful of the needs of general literature, and even art, has been steadily collecting the periodical literature of the world. It aims to gather from all quarters the memoirs of learned societies, the publications of museums, institutions, academies, and of scientific de-

partments of governments. Other libraries in America devote themselves to special subjects; no one has found the means, or has had the desire, to make a great collection of this nature. Professor Henry frequently said that cooperation, not monopoly, is the watchword of the Smithsonian Institution. Its policy has always been to devote itself to such useful fields of labor as no other institution could be found ready to take up."

Thus, by gathering together the results of nearly a century of the world's research and by making them freely available to investigators, the Smithsonian library has been an effective instrument in the work of the Institution.

The International Exchanges

In all civilized countries, learned organizations publish the scientific papers of their investigators. Science knows no national borders. Though politically at odds, with their countrymen nourishing antipathies against each other, the scientific men of all countries use and trust one another's published work implicitly. Honesty and accuracy of statement are so universal that the research man of one country builds confidently on the work reported in all others. Hence nothing promotes scientific progress more rapidly than international cooperation. A knowledge of what other men are doing gives the investigator new ideas applicable to his own problem and prevents him from wasting effort in learning anew what is already established.

The idea of setting up a system of exchanges of publications with foreign nations was a stroke of Secretary Henry's genius. It is one of the Smithsonian's activities that has remained in growing operation from shortly after the founding of the Institution to the present day. Many of the early lines of Smithsonian endeavor either grew beyond the power of its slender means to continue, or having developed into going concerns, were turned over to the administration of some agency as well or better

qualified to supervise the work. The Smithsonian's policy from the beginning has been to reserve the use of the income of its endowment for those enterprises which could not well be undertaken by other organizations. But the exchange of publications among the nations of the world seemed to be peculiarly the task of the Smithsonian, being manifestly an outstanding method of diffusing knowledge. Since its inauguration the free exchange of the published results of research in every branch of science among the civilized nations has been of incalculable benefit to the advancement of learning and its application to the welfare of man.

The International Exchange Service, as now constituted, acts literally as a clearing house for scientific information. In conjunction with similar agencies in practically every country on earth, it assists in disseminating the march of knowledge, so that an investigator in any particular locality may know what his fellow investigators in every other part of the world are accomplishing. To show how this exchange actually works, let us suppose that Prof. John Smith, of one of the great State universities, has just published in the university's series of publications the results of several years' work on the value of proteins in the diet. He has his list of those who he knows are working on this same problem in other countries, and also a list of many foreign libraries where he wishes his researches to be available for future students of the subject. He has each book wrapped in a separate package, and addressed to the individual or institution to receive it, and ships the whole lot in a box or several boxes to the International Exchange Service, Smithsonian Institution. With no further expense or responsibility, he may now feel assured that each copy will reach its destination safely and promptly through the channels of the Exchange Service.

When Professor Smith's books reach the Smithsonian, they are unpacked, given a record number, and sorted

PLATE 18

"Horseless carriage" made by Charles E. Duryea in 1892–1893; in the National Museum's collection of early automobiles

Costume worn by Mrs. Garfield, in the National Museum's exhibit of costumes of the wives of the Presidents from Washington to Coolidge

by countries. Those intended for addresses in New Zealand, for example, are boxed with other material for that country received from other individuals and societies in the United States, and shipped in the next sending to the Dominion Museum at Wellington, the official exchange agency for New Zealand. On arrival at Wellington, they are again unpacked and distributed directly to the individual addresses without cost. The same procedure is followed with packages addressed to all other countries, and at the end of a few weeks, or for the most distant points, a few months, Professor Smith's volumes are in the hands of all of his foreign coworkers, with practically no expense to him and with little danger of loss or damage in transit.

Before the Smithsonian undertook to promote the world-wide interchange of scientific publications, there had been three attempts of a somewhat similar nature, though more restricted in scope. In France, a system was introduced with considerable success of exchanging among several nations the surplus material of public libraries and government documents. In this country, two attempts were made to inaugurate international exchange of publications, one by the American Philosophical Society of Philadelphia and the American Academy of Arts and Sciences of Boston, the other by the National Institute of Washington. Both of these American exchange plans were primarily for the benefit of the societies themselves and did not long survive. The Smithsonian plan, on the other hand, had in view the mutual interchange of transactions and publications in all fields of science throughout the world, with no thought of direct benefit to the Institution itself through the exchanges.

This international exchange, which it was confidently expected would result from the wide distribution which the Institution planned to make of its own publications, was made a definite policy at the very beginning of the Smithsonian's active life. It was at first restricted to the

Institution and its foreign correspondents. In 1848, the first Smithsonian publication appeared, the famous monograph by Squier and Davis, "Ancient Monuments of the Mississippi Valley," and in accordance with the announced policy, it was distributed during the following year to nearly two hundred learned societies in South and Central America, Europe, Asia, and Africa. This wide distribution not only resulted in the receipt of a large number of valuable scientific publications in exchange, but in the important step described by Secretary Henry as follows:

"The promotion of knowledge is much retarded by the difficulties experienced in the way of a free intercourse between scientific and literary societies in different parts of the world. In carrying on the exchange of the Smithsonian volumes, it was necessary to appoint a number of agents. . . . These agencies being established, other exchanges could be carried on through them and our means of conveyance, at a slight additional expense owing to the small increase of weight; and we have accordingly offered the privileges of sending and receiving small packages through our agency to institutions of learning, and in some cases to individuals who chose to avail themselves of it; the offer has been accepted by a number of institutions, and the result cannot fail to prove highly beneficial, by promoting a more ready communication between the literature and science of this country and the world abroad."

The system developed rapidly, and the following year, 1852, nearly five thousand publications were received in exchange from abroad. In his report for this year, Professor Henry says:

"The principal object, however, of the distribution of the Smithsonian volumes is not to procure a large library in exchange, but to diffuse among men a knowledge of the new truths discovered by the agency of the Smithsonian fund. The worth and importance of the Institution

is not to be estimated by what it accumulates within the walls of its building, but by what it sends forth to the world. Its great mission is to facilitate the use of implements of research, and to diffuse the knowledge which this use may develop."

By 1854 the international exchange of publications was on such a firm footing that practically all foreign countries admitted Smithsonian packages duty-free, and all such material coming to this country addressed to the Smithsonian was admitted without detention and free of all duty charges, so that Professor Henry was able to describe the system in this year as the most extensive and efficient exchange service which had ever been established in any country. From this time forth, the Exchanges continued to increase steadily in scope and usefulness, until by the year 1880, despite the generous cooperation of transportation companies and governmental customs services, the cost of the work to the Smithsonian amounted to nearly ten thousand dollars a year, at that time practically one-fourth of the Institution's entire income.

Realizing the great importance to science of these Exchanges, the Institution continued to support the work from its slender income, although at the same time repeatedly urging upon Congress the justice and necessity of aid from the public funds. Finally in 1881 Congress granted a first appropriation of $3,000 for the International Exchanges, and this public support has been continued to the present time. Gradually increasing with the steady growth of the Exchange Service, the annual appropriation now amounts to nearly $50,000.

From the very beginning, the Smithsonian Exchange Service was made use of by the various bureaus of the Government to exchange their publications with similar governmental agencies abroad. For sixteen years this haphazard system of exchanging official documents was continued, the Institution in this time carrying over twenty thousand packages of government publications.

This phase of the work alone required the expenditure of over eight thousand dollars of the Smithsonian's private funds, and it was realized, as the work increased in volume, that some more definite and equitable arrangement would be required. Congress realizing at the same time that a fuller and more systematic exchange of official documents with other governments was desirable, enacted a law in 1867 requiring:

"That fifty copies of all documents hereafter printed by order of either House of Congress, and fifty copies additional of all documents printed in excess of the usual number, together with fifty copies of each publication issued by any department or bureau of the Government, be placed at the disposal of the Joint Committee on the Library, who shall exchange the same, through the agency of the Smithsonian Institution, for such works published in foreign countries, and especially by foreign governments, as may be deemed by said committee an equivalent; said works to be deposited in the Library of Congress."

Although no appropriation was made to put this exchange into effect, nevertheless Secretary Henry entered at once into correspondence, through the State Department, with a great many foreign governments, requesting their cooperation in the project, and nearly all replied with offers to send full sets of their official publications in exchange for those of the United States. Means were finally available in 1873 to carry out this arrangement, and in that year the Smithsonian began the shipment abroad of Government documents. Soon after this, the general exchange among nations, not only of governmental publications, but also those of scientific societies and institutions, was the subject of discussion at the meeting in Paris of the International Geographical Congress, and following this meeting, conferences were held in Brussels in 1877, 1880, and 1883. At the last of these, articles of agreement regarding the proposed exchanges

were drawn up and submitted to the various governments concerned, and after three years, at a final conference, the articles were signed by accredited diplomatic representatives. In the United States, this Brussels convention of 1886 was approved by Congress and ratified by the President in 1888.

The agreement consisted of two distinct parts, the first providing for the international exchange of official documents and scientific and literary publications; and the second for the immediate exchange of the official journals, parliamentary annals, and documents of the various nations ratifying the conventions. The Smithsonian Institution was recognized by the Department of State as the official agent of the United States in carrying out the provisions of the conventions. The plan was agreed to by eight nations, namely, Belgium, Brazil, Italy, Portugal, Servia, Spain, Switzerland, and the United States. It will be noticed that a number of the principal nations are not included in this list, but special arrangements were made with them for the exchange of publications, and a number of other countries have since adhered to the Brussels conventions.

In carrying out the first convention, which provides for the exchange of governmental, scientific, and literary publications, the Exchange Service aids libraries, universities, learned societies and institutions, and individuals in distributing their publications throughout the world. In return for these, the publications of similar institutions abroad are collected and forwarded by the exchange agencies abroad to the U. S. exchange service, and these are promptly distributed free of charge to the addresses in this country.

In a great many instances, the Exchange Service has conducted special operations which have been of inestimable value to particular institutions. For example, the libraries of a number of institutions in Belgium and France were destroyed during World War I, and several appeals

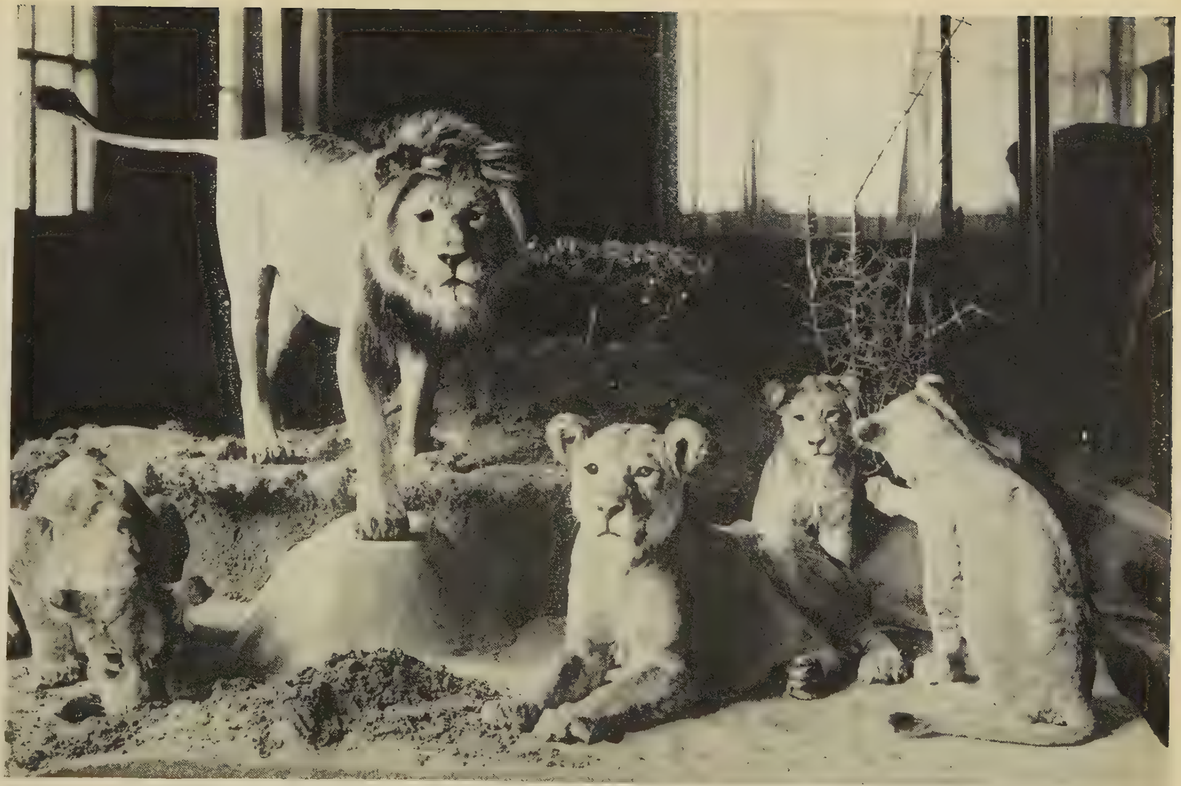
for books to rebuild these collections were received by the Exchange Service, through which many hundreds of publications were dispatched abroad for this purpose.

To give an idea of the constant growth and present magnitude of the work of the Exchanges, I will give a few figures showing the number of packages of publications handled annually by the Service since its organization. In 1852, the first year for which figures are available, 1,209 packages were handled, including those sent abroad and those received in return. By 1860 the number had reached 4,822, and in 1870, 5,510. In 1880, the total was 20,845; in 1890, 82,572; in 1900, 113,563; in 1910, 221,625; in 1920, 369,372; and in 1940, 639,344. Thus since its beginning, the work of the Exchange Service has increased more than five hundredfold. The weight of the more than half a million packages handled during 1940 was 527,545 pounds. The number of domestic and foreign correspondents of the Exchange Service has increased almost in proportion to the number of packages. Starting with a few hundred in 1850, the list of addresses had reached 63,605 in 1910.

In wartime, the operations of the International Exchange Service are necessarily greatly curtailed because of the restrictions on shipping and other means of transportation.

So ever since its founding, the Smithsonian through its Exchange Service has been distributing at home and in foreign lands hundreds of thousands of published results of researches in every field of scientific endeavor. Who can estimate the value of this world-wide interchange of ideas in the promotion of science and its application to the welfare of mankind? Hardly a library in the world, hardly a university, a scientific society, hardly even an individual of standing among the ranks of scientists but has received aid through the ready access to the publications of all nations made possible through the system of International Exchanges.

Taxidermists' workroom, National Museum, where animals are mounted for exhibit



Mounted group of lions in the National Museum. Shot by Theodore Roosevelt on the Smithsonian-Roosevelt African Expedition in 1909

International Catalogue of Scientific Literature

In the United States there are now being published more than five hundred periodicals devoted not at all to fiction or literary, historical, and biographical articles, but to the publication of new work and discoveries in the sciences. Some of these journals include in a year hundreds of articles by individual authors, each on a special subject. Some journals relate only to biology, others to physics, others to chemistry, or to other sciences.

Foreign countries are in more or less the same condition. Thus every year a new army of tens of thousands of scientific research children is being marshaled into the world. Some will become the giants of the scientific horizon of the future, while many others will but see the light and die. It is easy to see that among this vast multitude of scientific papers printed in English, French, German, Italian, Spanish, Scandinavian, Russian, Polish, Greek, Japanese, and other languages, there is a very fair probability that some will relate almost exactly to the research which Dr. James Brown, let us say, is engaged upon in America.

As it is merely marking time to do the same things over and over again, with sometimes better, sometimes worse conditions of accuracy, it is clear that scientists must have some way of knowing what others are doing, if the world is not to stop or greatly retard its advance into the immensity of the unknown. This is the quandary which gave rise to the International Catalogue of Scientific Literature, to special journals of scientific abstracts, and to similar digests.

As far back as 1855 Professor Henry recognized the need of such a catalogue and attempted to make it a reality through international cooperation. He was not successful in this, however, and it was not until 1882 that his ideas were partially put into effect by the Royal Society of Great

Britain, which in that year began the publication of its *Catalogue of Scientific Papers.* This was continued for twelve years, until in 1894 the greatly increased scope of the work forced the Royal Society to realize that this project was too big to be carried through by any one society, or even by any one nation.

Acting upon this realization, the Royal Society called the matter to the attention of the various governments, with the result that there was held in London in 1896 an international conference by representatives of twenty-three nations. The United States sent as delegates Dr. John S. Billings and Prof. Simon Newcomb. The desirability, in fact the necessity of an international catalogue of scientific literature was unanimously agreed upon, and this first conference was followed by a second in 1898 and a third in 1900, at which the various plans presented for the organization were perfected and the schedules of classification of scientific literature were prepared. Mr. Leonard C. Gunnell, formerly in charge of the U. S. Bureau of the Catalogue, described the project as follows:

"The organization is briefly this: All the principal countries of the world, at present numbering thirty-two, undertake to prepare at their own expense a classified index of the current scientific papers published within their domain, and to forward the data to a central bureau in London, where it is assembled and published in seventeen annual volumes, one for each of the following named subjects: Mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, physical geography, paleontology, general biology, botany, zoology, human anatomy, anthropology, physiology, and bacteriology. The cost of maintaining the central bureau and of printing the catalogue is defrayed entirely by funds received from the subscribers to the work. The regional bureaus are, as a rule, maintained by direct government grants. The work began with an index to the literature

for the year 1901. Supreme control of the catalogue is vested in a body known as the International Convention which met in 1905 and in 1910, thereafter to meet every ten years."

The catalogue consisted of one volume each year for every branch of pure science as listed above. Each volume was divided into two parts, the first consisting of an index by authors, the second of a classified subject index so arranged through the use of classification schedules that the literature on any desired subject may easily be found. The classification schedules, prepared by eminent specialists, included all of the minute subdivisions of the major branches of science; and with the realization that the trend of thought and investigation in all of the sciences is constantly in a state of transition and development, the schedules were made sufficiently elastic to provide as far as possible for the needs of the future. Through its system of classification, the International Catalogue was more than an index—it was a condensed digest of the scientific literature of the world.

Subscribers were secured in the various countries participating, and to these the seventeen annual volumes were sold for eighty-five dollars per set. One thousand copies were printed of each issue, and at the second convention, held in 1910, after the Catalogue had been in existence for ten years, it was reported that the annual cost had been $36,855 and the annual income $35,000. There was, thus, up to 1910, a slight annual deficit; but by 1914, the first year of World War I, receipts and expenditures practically balanced. In summing up the accomplishment by the Catalogue up to that time, Prof. Henry E. Armstrong, the dean of the enterprise and chairman of its executive committee, wrote:

"The progress made in the publication of the International Catalogue since its foundation in 1900 is nothing short of remarkable. Two hundred and forty-two volumes

have been published, indexing the scientific literature of the period 1901–1914. An extraordinarily broad, sound foundation has been laid, and much helpful experience gained. The difficulties that were expected to arise have either been nonexistent or were easily overcome. To have established so complete an organization on a thoroughly successful working basis is in itself a feat of no mean order, and most creditable to all concerned, not only to the staff of the Central Bureau but also to the various regional bureaus.

"The real difficulty by which the work has always been hampered is want of a working capital; this has affected both the Central and the regional bureaus. Had funds been always available, publication would have been far more rapid and the work might have been more fully developed. Almost every criticism that has been leveled at the Catalogue involves its extension, and therefore additional expenditure."

The work of the regional bureaus in the various cooperating countries consisted essentially in collecting, classifying, and indexing on cards all of the scientific literature appearing in each country during the year, and forwarding these cards to the Central Bureau in London, where they were assembled and prepared for publication.

The U. S. Bureau, under the direction of the Smithsonian Institution, collected each year data from 550 periodicals which regularly contain scientific papers, from over 400 others that occasionally publish articles of a scientific nature, and finally from book notices, reviews, publishers' lists, and the publications received in exchange by the Smithsonian Institution. From this mass of material there were prepared each year from 25,000 to 30,000 cards, classified according to the subject schedules.

With the advent of World War I in 1914, the Catalogue, in common with many other international enterprises, was seriously handicapped, and with the completion

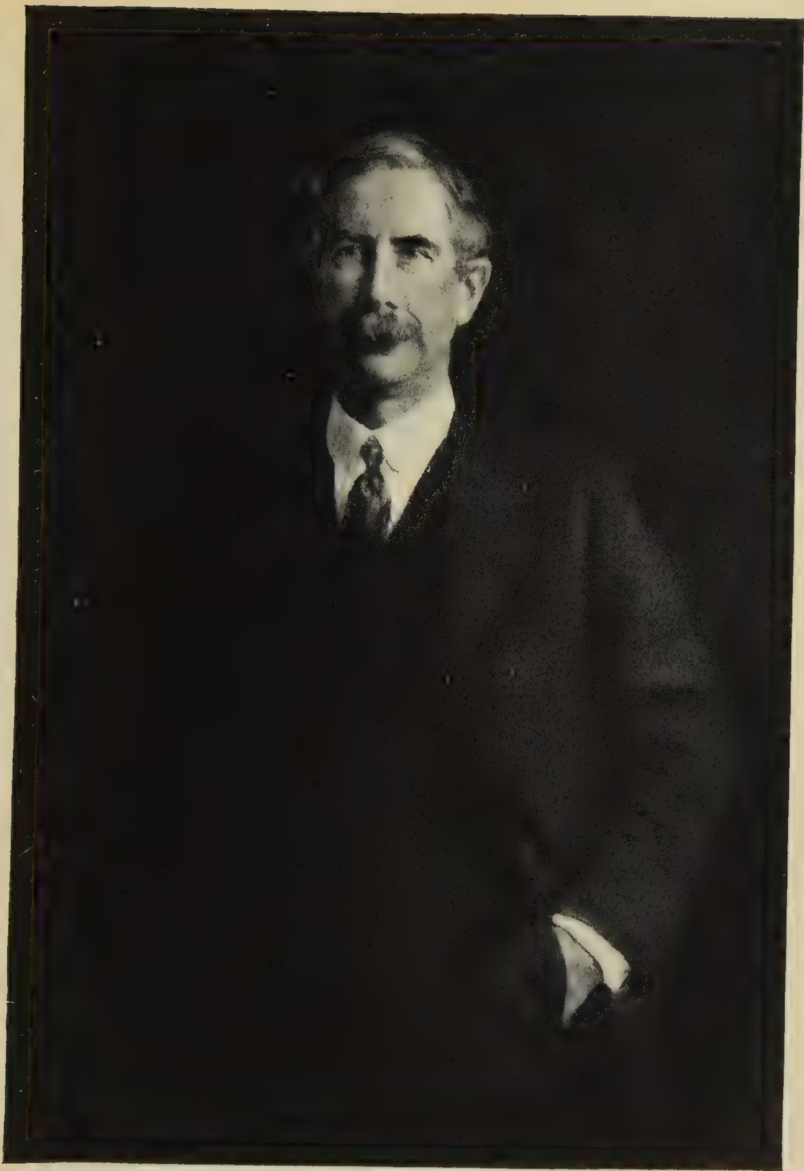
of the printing of the volumes for 1914, it was found necessary to suspend publication. Subscribers in many of the nations involved in the conflict failed to make payments, and this in conjunction with the rapidly rising cost of publication made it utterly impossible to continue printing.

CHAPTER V

MEASURING LIFE-GIVING SUN RAYS

Far away on the edge of the nitrate desert of Chile, at 9,000 feet elevation, where rain is almost unknown and one can ride for miles without seeing a living thing—animal, bird, reptile, insect, or even a wisp of vegetation—is located a lonely outpost of the Smithsonian Astrophysical Observatory. Another station similar to it but located in a more hospitable environment is perched on the summit of Burro Mountain, New Mexico, altitude 8,000 feet. Although there is some rainfall at this station, almost all of it comes in the months of July to September. It therefore supplements admirably the observations in Chile, for there the worst observing months are December to February. All water for the use of this station must be hauled up the mountain from a point two miles lower down. A third station stands on the top of Table Mountain in California, 7,500 feet in altitude, overlooking the Mojave desert. On nearly every day of the year, the men at these stations make precise observations of the heating power of the sun's rays. These measures are then ground for hours through the abstruse mathematical mill until they show what the sun is doing outside the atmosphere altogether. Then they are telegraphed to Washington where they are analyzed and published to tell the world how intense are the sun rays on which its life depends.

Let us consider for a moment the sun itself and the part it plays in terrestrial affairs. We could not live on



Charles Greeley Abbot, present Secretary of the Smithsonian Institution

Frame buildings of the Astrophysical Observatory back of the Smithsonian Building where studies of solar radiation began

the earth at all if it were not that its average temperature lies between the freezing and boiling points. That the climate of our earth remains within these limits is due to the fact that its temperature is in a balance, warmed by the incoming rays from the sun, and cooled off by the outgoing rays from the earth. Furthermore, without the chemistry of the sun's light there could be no plant life, upon which, in the end, all animal life depends. It is strange indeed, that it was not until the beginning of the present century that any measurements of the solar radiation approaching exactness were made. It is even more strange that, considering the fundamental nature of researches on the source of our life and warmth, the Astrophysical Observatory of the Smithsonian Institution is the only agency in the world today making a general study of the sun and earth rays. It is a welcome index of awakening public interest that the National Geographic Society in the year 1925 made a grant to Doctor Abbot to enable him to select the best site in the Eastern Hemisphere, equip it for these important researches, and maintain there for several years a new observatory under the title "The National Geographic Society Solar Radiation Expedition Cooperating with the Smithsonian Institution." The new observatory was installed on Mount Brukkaros in South West Africa in October, 1926. For various reasons this station was moved to Mount St. Katherine in 1933, and again to Burro Mountain, New Mexico, in 1938.

The center of attraction of our solar system, about which the planets including our earth and moon revolve, the sun is an immense body 865,000 miles in diameter, about 93,000,000 miles distant from the earth. Such is the enormous size of the sun that if it were hollowed out and our earth placed in the center of it, the moon could revolve about the earth in an orbit as great as its present one in the sky without approaching to the outside of the sun. Although dazzlingly hot, so hot that an arc light would look brown against its surface, no burning

fuel supplies the sun's heat, for even oxygen and hydrogen would fly apart at that tremendous temperature. Though denser than water, it is the heavy gases of superincandescent iron and carbon, and all the other chemicals which on earth combine so freely, that make up the sun. There, however, they are so hot that the most refractory of them can neither liquefy nor solidify nor combine to form any compounds. Even their atoms are burst asunder in the fierce heat, into the fundamental electrons and nuclei of which they are composed.

Till recently we had no hint of how this immense cauldron of incandescence received sufficient heat continually to supply the loss of rays which every year, even over the tiny angle of our earth's cross-section as viewed from the sun, amount in energy to the burning of over a hundred trillion tons of anthracite. These rays have poured out with equally tremendous prodigality for hundreds of millions, even billions of years. Now it is the belief of astronomers, as stated unqualifiedly by Jeans, that:

"The normal process of generation of energy in a star certainly requires the annihilation of electrons; there must, for instance, be many fewer electrons in the sun than in Plaskett's star of mass seventy-five times greater, or V Puppis of mass nineteen times greater. These stars are destined in time to become similar to the sun, and by the time they are similar, most of the electrons they now contain will have been annihilated in the process of transforming matter into radiation. The only way in which an electron can be annihilated is by coalescing with a nuclear proton."

Such is the source of energy of sun and stars according to leaders of modern astronomy. According to Eddington the sun contains matter enough to radiate at its present rate for fifteen trillions of years.

There are often observed on the surface of the sun dark spots which cross slowly over the disk owing to

the sun's rotation. Although dark against their dazzling surroundings, even in these spots the sun's temperature exceeds that of the incandescent electric light. Many of these sun spots are of enormous size, so large, in fact, that the whole earth might be dropped into one of them without touching the sides; and if this occurred, so great is the temperature on the sun, our earth would quickly turn to vapor and disappear. They wax and wane in numbers in a cycle of about eleven years, and along with their variations go changes in the terrestrial magnetism, the aurora borealis, and the weather.

When Dr. S. P. Langley came to the Smithsonian in 1887, he had already won wide repute as an astronomer and physicist whose prime interest was the study of the sun, and in accepting the position of Secretary of the Institution it was understood that an observatory was to be provided to enable him to continue his researches. In 1891 private means provided funds for a frame building which was erected back of the main Smithsonian building, instruments which Langley had already bought or constructed were installed, and the work was begun. The frame building still stands and is used today in the work of the Smithsonian Astrophysical Observatory. This very modest equipment initiated a research whose results may yet bring about a revolution in methods of forecasting the weather.

Langley's early work on the solar radiation was done with an instrument of his own invention—the bolometer, a supersensitive electrical thermometer, which consists essentially of a metallic tape about one-half of an inch in length but narrower and much thinner than a human hair, through which an electric current continually passes. The slightest variation in the amount of heat falling on this wire will affect the flow of electric current through it, which change is registered by the motion of a beam of light from a tiny mirror across a moving photographic film. The mirror is about the size of the head of a pin and

is turned by the passage of varying electric currents near little magnets no larger than the point of a needle. By use of the bolometer, the sun's spectrum map was extended by Langley to eight times the length that was known to Sir Isaac Newton. By means of these bolographic studies much knowledge was gained regarding the transmission of the sun's rays through the atmosphere, and beginning in 1902, determinations of the intensity of the sun's heat as it would be *outside our atmosphere* were made. It was noticed as early as 1903 that there appeared to be considerable variation in the amount of this solar radiation. We see instantly what excitement this apparent discovery must have produced because of the dependence of our weather on sun rays. Regarding two charts which he prepared, one showing the course of solar radiation during 1903 and the other showing the march of normal temperatures throughout the world during the same year, Langley in 1904 made the following statement, remarkable in view of recent developments:

"It may be said of the two charts that they both exhibit a remarkable falling off about April 1, 1903, and that the fall of temperature would be a natural result of the observed fall in solar radiation. But the subject is one of much difficulty, and the period of observation still far too short to warrant more than the conclusion that further study may prove of the highest importance in foretelling the changes of climate on which the conditions of coming harvest depend.

"The immense importance to us of such foreknowledge as will enable us to forecast the harvests and in other ways look into the future need hardly be insisted on if we can get it, and we apparently can get it only from such studies as these, which is a justification of the existence of our astrophysical observatory."

Langley used to speak in this connection of Joseph's prophecy of seven years of plenty and seven years of famine in the land of Egypt, whose god indeed the sun

was, and to express the hope that as a result of the solar work, we might some day be able to emulate the Hebrew prophet.

In 1895, Dr. Charles G. Abbot, present Secretary of the Smithsonian Institution, was added to the staff of the Astrophysical Observatory, and working under Langley's direction he soon acquired a similar enthusiasm for the study of the sun. Today Doctor Abbot has the satisfaction of seeing at least a partial fruition of Langley's dream, due to his own years of skillful and painstaking research. Stronger and stronger is becoming the evidence of the direct dependence of our weather on the earth upon the variations in the sun's heat. The Argentine Government for several years actually used the Smithsonian's daily values of the solar radiation in issuing forecasts of the temperature and rainfall for the region about Buenos Aires for a full week in advance.

Doctor Abbot's success in advancing so rapidly the progress of this difficult and technical research is undoubtedly due to his enthusiasm and absorbing interest in the work. As Director of the Astrophysical Observatory from the time of Professor Langley's death, he devoted himself unremittingly to the solar investigations. With the increased demands upon his time by administrative duties which came with his appointment as Assistant Secretary of the Smithsonian in 1918, and as Secretary in 1928, he so managed to work the two together that there was no appreciable diminution in the progress of the solar research work. Doctor Abbot's versatility as well as his tireless energy is shown by the fact that in addition to these two major occupations he has found time to write several books and many articles, a number of them popular science stories for children's magazines; to take a prominent part in the affairs of one of the largest churches in Washington; and in recent years, realizing the benefit of outdoor exercise, he has become a golf enthusiast.

In the early stages of the investigation it was recognized

that a standard instrument must be developed for exact measurement of the sun's heat. By 1910 there had been perfected what is termed the "standard water-flow pyrheliometer," the principle of which consists in measuring the intensity of the sun's heat in terms of the rise in temperature of a known weight of water caused by the complete absorption of solar rays over a known area in a given time. Known quantities of heat may be introduced electrically to check the accuracy of the instrument, which is generally recognized now as the standard of the whole world. With the results given by this instrument have been compared, from time to time since 1910, those obtained from other devices for measuring the sun's heat, so that its standard scale may be copied and used generally. Another instrument, known as the "silver-disk pyrheliometer" was also developed by Doctor Abbot, which has proved to be highly satisfactory for the daily observations. There have been made and standardized in the Smithsonian shops more than fifty of these silver-disk pyrheliometers, which have been furnished at cost to observers requesting them in all parts of the world, and thus the Smithsonian standard scale of solar-radiation measurements has been widely diffused.

By the year 1908 many evidences of solar variability, or in other words evidences that the sun, like many other stars, is a variable one, had been accumulated by the Smithsonian expeditionary work on Mount Wilson. But the question Doctor Abbot asked himself was this: May not these apparent changes, notwithstanding our care, be caused by changes really produced in the ocean of atmosphere above our station, and not in the sun itself? To resolve this, he took two costly but obvious steps in the succeeding four years. The first was to prepare a complete duplicate outfit for the observations and to make use of it himself on Mount Whitney, at 14,500 feet, the highest peak in the United States outside of Alaska, while colleagues observed as usual at Mount Wilson.

PLATE 24

Mr. A. F. Moore measuring the radiation of the sun at the Smithsonian's station on Table Mountain, California

PLATE 25

Desolate nitrate desert region of Chile, with Smithsonian Astrophysical Observatory station in foreground

Both in 1909 and in 1910 he occupied Mount Whitney, where wood for fuel had to be carried on mule-back at $60 a cord, and water had to be melted from ice gorges for drinking and washing. Amid the deep cerulean blue of the usual sky, sudden storms of snow, or fog caps covering only the mountain peak, frequently interrupted the observing.

On the way up, at 13,000 feet, while a trail was being cut across the face of the glacier, one of the pack mules, becoming impatient, pushed another off the narrow path, from which he fell 400 feet. The mule was killed, but Doctor Abbot's most delicate instrument, which was upon the mule's back, was fortunately uninjured. Arrived at the summit, the Mexican packer demanded and received $100 for his mule, but the Comptroller of the Treasury disallowed repayment, because, as he said: "The Government cannot insure common carriers!"

As a result of the simultaneous observing at Mount Wilson and Mount Whitney no difference was disclosed in the solar-radiation results when reduced to conditions outside our atmosphere, whether measures were made at 5,800 or at 14,500 feet elevation. In 1913 this reassuring indication was greatly strengthened. Automatic instruments were invented and employed by Mr. Aldrich under Doctor Abbot's direction and with the cooperation of the Weather Bureau, which being carried up by free balloons to fifteen miles of elevation, further confirmed the result, namely: By suitable methods the sun's radiation as it is outside the atmosphere may be estimated correctly from measurements made in fine weather from any altitude from sea-level to fifteen miles.

But the fluctuations found were so small, only a few per cent in magnitude and yet so important if real, because all weather hangs on sun rays, that a further test had to be made. Doctor Abbot carried his duplicate set of instruments to Algeria in North Africa, and there in 1911 and 1912 made daily observations while his col-

leagues continued the work at Mount Wilson. The results indicated that though observing at stations separated by one-third the circumference of the earth, and at different levels above the sea, and through different sections of the ocean of atmosphere above us, yet the two stations agreed substantially as to their findings of the variation of the sun.

With this encouraging confirmation, the work was carried on with increasing enthusiasm at Mount Wilson. Its importance was the more enhanced when Mr. H. H. Clayton, Chief Forecaster of Argentina, communicated results to the Smithsonian which seemed to show that the world's weather is affected to a marked extent by the observed changes in the sun's radiation. Doctor Abbot began to feel that owing to the probability of a connection between the variations of the sun's heat and those of our weather, it was highly desirable for the Smithsonian to promote observations every day in the year at two widely separated stations, instead of only during a few months of the year at one station as formerly. Australian cooperation having been postponed because of World War I, plans were approved by Secretary Walcott in 1917 for the use of a part of the income from the Hodgkins Fund of the Smithsonian Institution to establish a second station in South America. This was delayed, however, by the entry of the United States into the World War in that year, and a temporary station was erected on Hump Mountain, North Carolina, where observations were made for nearly a year under all sorts of weather conditions. On one day, measurements were carried through there with good results—out-of-doors, of course—with the thermometer standing at five below zero. Mr. L. H. Abbot, assistant at the station, froze both feet and several fingers in the course of the observations.

By 1918 conditions were such that it was possible to resume the South American program, and in June of that year an expedition arrived in Chile to establish the new

station. The region selected as being most suitable from a meteorological point of view was the great Atacama nitrate desert, for it practically never rains there and even clouds of any sort are a very rare occurrence. Through the courtesy of the Guggenheim Company, which operates a great copper mine at Chuquicamata, employing several hundred Americans and more than 10,000 natives, a furnished building near Calama, on the edge of the desert, was placed at the disposal of the expedition and actual observations were begun in July, 1918. These were continued on every possible day for two full years, and although the dust and smoke from the city and the neighboring mine at times affected the otherwise perfectly clear atmosphere, nevertheless as a whole the observations were excellent and in remarkable accord with the Mount Wilson results obtained on the opposite side of the equator.

In 1919, Doctor Abbot himself visited South America with the threefold purpose of inspecting the Chile observing station, conferring with the officials of the Argentine Government relative to the use of the Smithsonian solar observations in weather forecasting, and observing the total eclipse of the sun which was to occur in the region of La Paz, Bolivia, on May 29. Regarding the eclipse, which Doctor Abbot successfully observed and photographed from the rim of a canyon near La Paz at 14,000 feet altitude, he wrote:

"It is difficult to describe the splendor of the eclipse phenomenon on this occasion. The corona extended at least two diameters of the sun in almost all directions, with a great profusion of fine streamers. Underneath the sun, that is to say toward the east, there hung a sickle-shaped solar prominence of hydrogen and calcium gases, extending fully 150,000 miles outward from the sun and over 300,000 miles long, which cast its crimson glory over all. The background against which this splendid phenomenon was seen was a range of mountains, perhaps fifty

miles distant, which raised their snow-covered heads fully 20,000 feet in altitude."

It was during this visit that a great step forward was made in the methods of the solar work. Langley's original method of observing the sun required several hours of perfect conditions, and to reduce these observations, twenty-five hours of measurement and computation were necessary. While at the Calama station, Doctor Abbot with the assistance of Mr. A. F. Moore, the director of the station, devised a brief empirical method which reduced the entire time of observation and subsequent computation to a few hours, enabling the observers to obtain the "solar constant" two or three times every day. More recently this method has been still further perfected and shortened, so that at the present time it is possible to make the necessary observations of the sun's heat in about fifteen minutes and to compute the results in less than one hour. Whereas with the older methods it was only by the utmost diligence and by computing well into the night that the two observers could get out a single value of the "solar constant" to represent each day, now it is possible to make and compute five independent observations on a single day, and all of these results are available for use on the afternoon of the day of observing.

From the establishment of the station in Chile until the present time, the Smithsonian has kept watch summer and winter on every possible day upon the intensity of sun rays. No other institution in the whole world joined in these pioneering studies until 1924, when the Argentine Government set up a solar-radiation observing outfit purchased from the Smithsonian at La Quiaca, a plateau station of 11,000 feet altitude.

Owing to the generous financial aid of Mr. John A. Roebling, the Chilean station was removed in 1920 to Mount Montezuma, twelve miles from Calama, and about 9,000 feet in elevation. At the same time, by Mr. Roeb-

ling's further support, the apparatus was removed from Mount Wilson to Mount Harqua Hala in Arizona. As this station proved a little unsatisfactory, it was again removed with Mr. Roebling's aid in 1925 to Table Mountain in California, at 7,500 feet elevation, and thirty miles northeast of Mount Wilson.

With these two stations, Montezuma and Table Mountain, there is now cooperating a third on Burro Mountain, New Mexico, and at all three, observations are made on every possible day. It is hoped by means of these three desert-mountain observatories to lay a basis in the coming years such as to warrant a definite answer to the question: Can the study of the sun assist us to forecast the seasons?

Already the work at these three observing stations has yielded results of great interest. For an analysis of monthly mean values shows that solar radiation responds definitely to the march of the eleven-year sun-spot cycle; and, more than that, a periodicity of 25⅔ months has been shown to exist.

In the meanwhile, others have shown that changes reaching sometimes to a full hundred per cent occur in the ultra-violet solar rays so important in medical science, and that these go hand in hand with the changes in total radiation observed by the Smithsonian; furthermore, that changes in the intensity of long-range daylight radio signals also run almost exactly parallel to the variations of solar radiation; and finally, that the world's weather seems to respond with an intricate but traceable connection to solar variations.

If these correlations are all verified, and if the 25⅔-month period of solar change persists, we may hope to forecast over two years in advance whatever phenomena may be found to depend on the variation of the sun. Whatever may be the outcome, it is sure that unless we in this generation diligently carry on the observations, the next generation will be as much at a loss as ourselves to answer

the question above propounded. That is the task which the Smithsonian Astrophysical Observatory sets for itself in the coming years.

Of course the connection between weather and solar radiation is a very complicated matter, and to give an idea of the difficulty of the subject, I will again quote Doctor Abbot:

"The reader might think it obvious that if the solar radiation falls the temperature would fall also. Nothing so simple as this occurs. For the earth's surface is so complex that its deserts, its mountains, its oceans, and other features, with the circulation of the atmosphere, modify extremely the effects of the solar heat. It is easy to see, for instance, that inasmuch as a quarter of the sun's heat is absorbed in the atmosphere itself, and as the atmosphere has but a trifling capacity for heat compared with the solid earth or the ocean, that its temperature must be almost immediately affected by solar variations, far more directly than the temperature of the ocean or the temperature of the land. But since the atmosphere is in some regions hazy, humid, and cloudy, in other regions dry and transparent, the quantity of solar heat absorbed must vary very much from place to place. So the changes in the solar heat must produce very different temperature effects in the atmosphere in a cloudless desert region at high altitude than they would in a cloudy, humid, hazy region where the air is contaminated, perhaps by the smoke of a great city.

"The consequence is that air expansion, due to the increased temperature accompanying increase of solar radiation, takes place in much larger proportion in the humid, hazy regions than it does in the cloudless, clear ones, and so the air must flow from the regions of the former condition to those of the latter. This produces changes in barometric pressure which in turn produce the winds and cyclonic movements which are so familiar. With the changes of season and other variable conditions,

the regions which are sources of these cyclonic disturbances move about from place to place. This alters the direction of the winds, and as is well known, the temperature depends intimately on the prevailing winds at every locality. This may explain why it is that we are not to expect at every station and at every time of the year colder weather when the solar radiation is lower. We may have exactly the reverse, depending on these secondary effects. Consequently the study of the dependence of weather on solar radiation must be very long-continued and thorough before it will be possible to hazard predictions based upon the variations of the sun, or even to know for certain that the variations of the sun are of importance for our forecasters."

However, the continued reports of weekly forecasting in Argentina based on the solar radiation invited a similar trial for the United States. Again through the generous financial and personal cooperation of Mr. John A. Roebling, arrangements were made to put the matter to a test. Mr. H. H. Clayton, who had inaugurated and conducted for several years the Argentine forecasting, undertook the work, and it was planned to make definite temperature forecasts for one typical region in the United States. For this purpose New York City was chosen, not only because of its importance as a center of commerce, but also because weather conditions in New York are of a highly complex nature, and if it should be found that successful forecasts could be made for that locality, it was probable that they could be made with greater success for almost any part of the United States.

Accordingly it was arranged for telegrams to be received at the Smithsonian each morning from the two observing stations in Chile and Arizona, transmitting in code the results of the observations of the sun in those localities on the preceding day. These results were reduced and combined at the Institution and the resulting final value of the "solar constant" was telegraphed before noon to

Mr. Clayton in Massachusetts, who on the same afternoon mailed back to the Institution his forecast for the temperature to be expected in New York City three, four, five, and twenty-seven days later, and for the coming week and month. After waiting for a complete year, these forecasts were then verified at the Institution by a mathematical method free from personal bias. The results proved to have been fairly successful with the exception of the definite 27-day temperature forecast. The three-, four-, and five-day forecasts, and the general forecast for the coming week and month showed a real prevision of the temperature in New York. In reporting on the year's work, Mr. Clayton, after enumerating the variable quantities which greatly complicate the forecasts, says in 1925:

"It is gratifying to know that notwithstanding these difficulties, forecasts have been successfully carried on for a year. A rigid mathematical method of verification proves them to be better than chance forecasts for an important station in the United States. There is every reason to suppose that these forecasts will go on increasing in accuracy as the data on which they are based increase in completeness and accuracy, and the knowledge of how these solar changes affect our atmosphere increases."

Thus many years after the variability of the sun's heat was first noticed at the Smithsonian, Langley's dream of utilizing the sun's status in foretelling weather gives promise of being realized. There is now surely a strong hope that as methods of observing, computing, and forecasting from the results improve, the Smithsonian's observations of the sun's variations will be of daily practical value to all the world.

Many other investigations on the sun and stars have been carried on at the Astrophysical Observatory during the thirty-five years of its existence. Several years ago Doctor Abbot began work on a solar cooker, employing a parabolic mirror which concentrated the sun's rays on a

Observing tunnel and instruments for studying the variation of the sun's heat, on Mount Brukkaros, South West Africa. Established by the National Geographic Society

tube full of mineral oil. The oil in this tube, on being heated, circulated continuously through a large reservoir, within which were ovens in which the cooking was to be done. This device at Mount Wilson was finally so perfected by 1920 that Mrs. Abbot was able to use it in cooking all meals for the Smithsonian expedition, employing only the sun's heat for fuel. As the ovens were located on the porch of the observer's cottage, Mrs. Abbot was much envied by the ladies of the neighborhood for her cool kitchen. For the present, however, this solar cooker must be regarded as a luxury for regions where the sun shines for a large percentage of the time, rather than as an appliance for general use.

Langley's epoch-making work on the solar spectrum is well known. Just recently Doctor Abbot has succeeded by using a Nichols radiometer in connection with the 100-inch reflecting telescope of the Mount Wilson solar observatory, in observing the heat of the brighter stars, and further, in separating this into a long spectrum and obtaining fairly accurate measurements of the distribution of heat of the different colors of the spectrum, even far into the infra-red. From a study of the spectral distribution in the radiation of the blue, white, yellow, and red stars, estimates of their probable temperatures were made, and from these results and by comparing the total amount of heat they send as compared with the sun, it was possible to estimate the diameters of the stars observed. The diameters thus indirectly computed matched closely those measured by the interferometer of Doctor Michelson. The combination of instruments, the 100-inch telescope and radiometer used by Doctor Abbot, could have detected the heat of a candle 3,000 miles away.

Other investigations conducted by Doctor Abbot with the cooperation of the other members of the staff of the Observatory, the late Mr. F. E. Fowle and Mr. L. B. Aldrich, include those on atmospheric transmission and absorption; studies of the reflecting power of clouds; the dis-

tribution of radiation over the sun's disk, and many other fundamental problems. But the main effort of the staff of the Smithsonian Astrophysical Observatory has been concentrated upon establishing the variability of the radiation from the sun and in perfecting methods of observing and computing these variations. For many years accurate records have been kept of the daily values of the solar radiation, and while these values promise to be of immediate utility in enabling us to foretell weather more accurately and farther in advance, they will probably be of even greater value and interest to students of the sun living a thousand years from now, since they will then be in a position to know whether or not the sun is gradually cooling off and declining, as many claim, "toward the condition of a cold body devoid of life-giving energy."

CHAPTER VI

OUR NATIONAL ZOO

PARTLY to embellish their great triumphs, and partly for the savage sport of pitting famished wild beasts against each other in the arena, the Romans maintained in captivity many living animals. From a large collection of bones of animals discovered by Dr. Aleš Hrdlička in Egyptian tombs which date from about 2,000 B.C., we know that the ancient Egyptians too kept captive wild animals for their amusement, prominent among these being the big bears. Throughout the history of Europe there are records of menageries and zoological gardens, and the famous collections still existing in London and Paris both had their origins several centuries ago through casual gifts of live animals to the ruling monarchs from friendly potentates. As far as we know, these early collections were badly kept and poorly exhibited. The crowded and poorly ventilated cages, combined with a lack of knowledge or care regarding the natural environment and food requirements of the various animals, led to a high death rate among the collections.

These European menageries of a few centuries ago were apparently far surpassed by those of the undiscovered New World, for we read of most magnificent animal collections of great extent and variety which were maintained by the Aztecs and Incas. Particularly well arranged and preeminent in the variety and size of the collections was the menagerie brought together by Montezuma, the last Aztec emperor of Mexico, for the instruction and

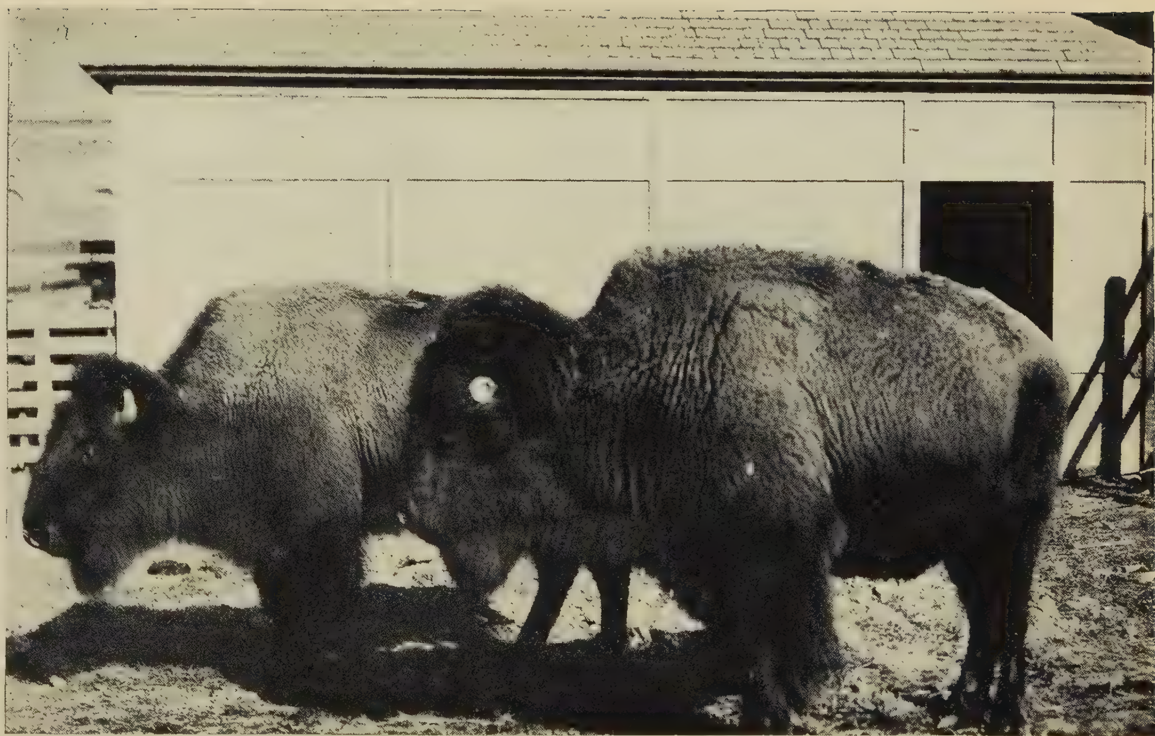
entertainment of his people. This collection, the account of which reads like a product of fiction, contained examples of the first American buffalo to be seen by Europeans, the animals having been transported several hundred miles from the northward for the Aztec menagerie. Unfortunately the conquerors of Mexico and other New World countries took no care to preserve these magnificent collections.

About 1860 gifts of live animals to the public officials of New York City formed the nucleus of a menagerie which developed into an important feature of Central Park. About ten years later a deliberate effort was made by the citizens of Philadelphia to establish a zoological park, and they succeeded in raising a sum large enough to make a beginning in Fairmount Park. The collection of animals increased rapidly, and although the space assigned to it was rather limited in extent, nevertheless, owing to the fact that the business was managed from the beginning with regard for the advancement of science, the Philadelphia Zoo has become one of the most important in America. The next zoological park to be established was in Cincinnati, and following this many other American cities saw the value of the exhibition of unfamiliar animals, until at the present time nearly every large city in the country has some sort of a zoological garden, many of these containing large and important aggregations.

In Washington, the zoological park idea developed directly from the activities of the Smithsonian Institution. An interesting version of the actual beginning of the present great collection was given recently by Mr. Theodore W. Noyes, editor of one of Washington's largest newspapers. The conversation was regarding the early days of the Smithsonian, and Mr. Noyes remarked that he had very vivid memories of the Institution during the eighties, as it was his very first assignment when he came to Washington as a cub reporter. Upon being

PLATE 27

William M. Mann, Director of the National Zoological Park, under direction of the Smithsonian Institution



American bison, kept at the Smithsonian as models for taxidermists in the 1880's, which formed the nucleus of the National Zoological Park

admitted to the building, he wandered down into the basement where he found a number of men engaged in the interesting occupation of administering chloroform to large snakes. When the reptiles were sufficiently under the influence, plaster casts were taken of them and these were used later in making lifelike models of the various species for exhibition in the National Museum. The snakes then came back to life and were put carefully back into their containers. Young Noyes went back to his paper and wrote such a live story for the next day's issue that the Smithsonian was deluged with visitors who wished to see the snakes. Doctor Langley, then Secretary, in order to meet this popular demand, had a number of the live snakes put in suitable cases and exhibited in the main hall of the Smithsonian building, where they attracted great attention from visitors.

During the eighties the Smithsonian assembled a considerable collection of live animals of various sorts, which were kept in temporary quarters at the rear of the Smithsonian building. Here they served as models for the taxidermists who were preparing specimens for exhibition and who needed to study the live animals in order to catch the natural attitudes and characteristics for the models to be displayed. These living specimens proved to be of such great popular interest that a Department of Living Animals was created, in charge of a well-known collector and taxidermist, Mr. William T. Hornaday. Within a few years over two hundred animals had been assembled and were kept in temporary structures in the Smithsonian Park.

This temporary arrangement was, of course, far from satisfactory because of the impossibility of showing the animals properly or of maintaining them in a healthy and contented condition. It was just at this time that the virtual extinction of the picturesque American bison, commonly known as the buffalo, was arousing widespread interest and indignation. These great animals, which are

intimately associated with all tales of adventure and daring in the pioneer days of our great western lands, once roved in immense herds over practically all of America as far east as Virginia. In their retreat westward before the advance of civilization, the thoughtless and wasteful slaughter of thousands of the bison soon reduced these vast herds to a small remnant, and they threatened to follow the great auk and other extinct forms of life which are now seen only in the exhibition cases of museums.

Secretary Langley, having in mind the prevention of the utter extinction of the bison, and also the exhibition of other animals of interest and value alike to the public and to the zoologist, conceived the plan of acquiring, before it was too late, a relatively large tract of land near Washington where live animals of all kinds could be shown in surroundings approximating as nearly as possible their natural environment. There came to mind at once the beautiful valley of Rock Creek, a small stream emptying into the Potomac, which has cut a deep valley through the surrounding hills, thus affording every variety of situation, from sunny ridges to cool wooded slopes and from rocky cliffs to grassy meadows. If such a site could be secured, a literal zoological "garden" could be provided, in marked contrast to the older zoological parks such as those of Europe, where in nearly every case the collections of animals were crowded together in small tracts, usually in the midst of a city, where it was not only difficult to maintain and exhibit the animals properly, but impossible to show them in anything approaching natural surroundings.

This plan of Langley's offered the double advantage of providing an unexcelled method of exhibiting living animals, and of giving to the people of Washington and the hundreds of thousands of tourists who annually visit the Nation's Capital a beautiful park which would preserve, in so far as possible, the native charm of Rock Creek Valley. Several influential members of the United States

Senate became interested in the project, and in 1888 a bill was introduced in that chamber by Senator Beck, of Kentucky, providing for the appointment of a commission to consist of the Secretary of the Interior, the head of the Commissioners of the District of Columbia, and the Secretary of the Smithsonian, who should select a suitable tract of land, arrange for its use as a zoological park, and finally place it under the administration of the Smithsonian Institution. This bill, though warmly advocated by several prominent members of both houses of Congress, failed of passage at that session, but was promptly introduced as a new measure in the next Congress as an amendment to the District of Columbia appropriation bill by Senator Edmunds. This bill, which became a law on March 2, 1889, went further and provided a sum of $200,000 for the purchase of a suitable tract of land.

Thus Langley's project became a reality—America was to have a National Zoological Park, located at the Capital, and in planning and developing the scheme its national character was kept constantly in mind. With excellent judgment and foresight, the commission selected from among all available lands a tract of some 175 acres in the most beautiful part of Rock Creek Valley, near several public roads and trolley lines. At the time of its establishment, the park was well outside of the city proper, but in recent years the rapid growth of Washington has entirely surrounded the Park with dwellings and it is now in the center of one of the city's best residential sections. Owing to the foresight of the founders, however, in providing such a large tract of land, the encroachment of the city does not detract in the least from the value of the park, but rather enhances it by making it more easily accessible to a larger number of people. Rock Creek Park, later provided by act of Congress, joins the Zoological Park on the north, so that now there is a very large tract of wooded land which will be permanently available for the pleasure and instruction of the public.

After some difficulty in locating certain boundaries of the tract selected, due to the obliteration of some of the old landmarks, the site was finally surveyed and in November, 1890, full possession was obtained by the Government. In April of that year, another act was passed by Congress placing the administration of the new zoological park in the hands of the Smithsonian Regents, and authorizing them to place in the Park any animals at that time on hand, to increase the collection by exchange, and to conduct the Park "for the advancement of science and the instruction and recreation of the people."

The Secretary and officials of the Smithsonian proceeded with vigor and enthusiasm to develop the new project. They realized at the start the necessity of building for the future, and with the vision in mind of making the National Zoological Park the finest thing of its kind in America, the advice of a landscape architect of world-wide repute, Mr. Frederick Law Olmsted, was enlisted in laying out the grounds, so as to secure the best arrangement of buildings, roadways, etc., for the purpose, at the same time preserving as far as possible the beautiful natural scenery of the Park. Mr. Olmsted made a number of visits to the site and submitted his plan, and although the limited appropriation for the purpose did not permit of carrying it out completely, the plan was followed in all subsequent development. The entire area was fenced in, a roadway was built through the Park, the grounds where the animal collection was to be located were improved and planted, and the first of the animal houses was erected. It was now possible to transfer the animals in the department of living animals of the National Museum, which had been huddled together in a shed and a few small enclosures in the Smithsonian grounds, to their new permanent quarters at the National Zoological Park. The collection at that time contained one hundred and eighty-five animals of many kinds, large and small. One of these "oldest inhabitants" was until recently an honored member of

PLATE 29

Bridge over Rock Creek in the National Zoological Park

the animal community—a sulphur-crested cockatoo which was received by the Smithsonian in April, 1890, and moved to the new quarters in 1891. This venerable bird was therefore in the collection for more than forty years and it was fully adult when first received. Employees who had been with the Park since its foundation said that the cockatoo had not changed the least bit in that time in appearance or vigor.

When the new National Zoo was thrown open to the public, it entered immediately into great popular favor, and the number of visitors entering the gates of the Park has mounted steadily every year since, until at the present time considerably more than two million persons visit the Zoo every year. Besides the thrill of seeing the savage beasts of the northern forests and tropical jungles "in person" and at close range, it is highly entertaining to the average person to observe the curious and diversified habits and dispositions of the various animals and birds. Furthermore there is a fascination for all those who have as children cared for pets of various sorts, in seeing the wild animals, many of huge size and ferocious aspect, cared for in the same way. The keepers at the Park, who are selected for their love of animals, come to have the greatest affection for their charges. Doubtless the keeper feels the same way toward his hippopotamus as we do toward our family cat. The great popular interest in the animals is a very valuable asset to the Park, stimulating the officials and employees to the greatest effort to increase the value and attractiveness of the collections.

Although the first year of the Park's existence was highly successful from every point of view and it was apparently well on the way toward a rapid development, it suffered an unexpected setback through a change in political administration which retarded its growth for several years. A great many of the earnest supporters of the project in Congress ended their terms as Congress-

men, and to the many new members the Park was an unknown affair. The appropriations, which had been carefully worked out by Secretary Langley to cover the actual expense of the operations of the Park and provide for a normal growth, were materially reduced; and even worse than this, the authority to purchase valuable and interesting animals as occasion arose was revoked, and in some quarters mention was even made of abolishing the entire scheme. Fortunately it did not come to this, but the growth of the collections practically stopped, as the only additions came through chance gifts or exchanges, and the accessions received in this manner proved to be not only few in number but practically all of commoner animals of which the Park already contained specimens. This state of retarded development continued for several years, but healthy growth was finally resumed and has continued to the present day.

In the year 1926 the collection of the National Zoological Park, which then contained about 1,700 mammals, birds, and reptiles, and particularly with respect to mammals was already one of the choicest collections in the world, was nearly doubled in numbers by the captures of the Smithsonian-Chrysler African Expedition which is mentioned later. The collection is especially rich in those rarer forms of animal life which are seldom seen in zoos.

To accomplish one of the purposes for which the Park was established by Congress, that of preventing the extinction of the American bison, specimens of this animal were secured early in the history of the Zoo, and by adding others as opportunity offered, a herd of considerable size was finally brought together. These are displayed in large paddocks where the animals have plenty of room to roam about, and a considerable number of young have been bred in the Park. The herd soon threatened to become too large for comfort, and through the exchange of the young ones to other zoos, it is now kept at about

seventeen head. Other institutions in this country and Canada followed the example of the National Zoo, and there are at the present time a number of flourishing herds of buffalo being maintained, both in captivity and in large reservations in the National Parks. All immediate danger of this famous animal's becoming extinct is now past.

In view of the rapid extermination of many wild animals and the extreme cruelty involved in the methods of hunting and trapping for the sake of furs and hides, it is a strange fact that there are a considerable number of almost fanatical "animal lovers" who object to animals being kept in captivity in zoos. Only recently there was an indignant outbreak against "imprisoning for life the noble bird that has been chosen to typify the proud, free, and lofty spirit of America." These well-intentioned persons do not realize that the hand of man is against the eagle in almost every part of the country; that in most States there is no law protecting them—in fact, in some a bounty is paid for destroying them; that egg hunters know their nests and rob them regularly; and that almost all of the eagles shown in the National Zoo have been brought in after having been either shot or trapped, and have been restored to health in the Park. Were they to be turned loose as recommended by these "animal lovers," they would undoubtedly be promptly shot.

It sometimes occurs, however, that the most violent objectors to the Zoo become its strongest supporters after spending a day inspecting the collections in company with one of the keepers. The keepers are selected for their love of animals, and in return for the kindness shown them, many of the animals display a real affection for their guardians. That they know and remember them is conclusively shown by the following remarkable incident in connection with a young hippopotamus which was born in the Park. He was appropriately nicknamed "Buster,"

and was a great favorite of the head keeper, Mr. Blackburne. After about two years in the Park, he was sent in exchange to the St. Louis Zoo in a special express car accompanied by Mr. Blackburne. Regarding the incident, Mr. Hollister, Superintendent of the Park at that time, wrote:

"For a large part of the trip the car was attached next behind the locomotive tender, and the young hippo was naturally distressed and nervous. He was perfectly contented and quiet, though, if Mr. Blackburne sat at the head of the crate and allowed him to suck his fingers, and as a consequence Mr. Blackburne spent the better part of one whole night in this position with his hand in the mouth of the baby hippo.

"On his arrival at the St. Louis Zoological Garden, the hippo was rechristened 'Steve,' and became a general pet and was known to everyone by his new name. Nearly two years later Mr. Blackburne and I were visiting the St. Louis Zoo and came into the hippo house with a number of other people, just at feeding time. The young hippo, now very much grown, was eager for his food, which was then being placed for him at one end of his large indoor inclosure. Mr. Blackburne hailed the animal with his old-time 'Hello, Buster!' just as he had done hundreds of times in Washington two years and more before. The response from the hippo was instant; he turned at the sound of the old name, and after Mr. Blackburne went back of the guard rail and the hippo had smelled of his hands and received the old-time pats on his great lips, absolutely identifying his old friend, he refused, for the time, to pay any attention to his food or his keeper. There was absolutely no mistaking his actions; he was at first startled, then puzzled, and then, as his memory awakened, highly pleased. His recognition was positive. It was a most interesting and instructive lesson in animal psychology, but had I not actually witnessed the performance, I am sure I should have been somewhat

European brown bear with cubs born in the National Zoological Park

PLATE 31

This youngster was born to the hippopotamus at the National Zoological Park

skeptical of a tale of such intelligence and memory on the part of a hippopotamus. Many interesting tales of the affection of animals for their keepers could be told by those familiar with the Zoo."

Three of the major classes of animals—mammals, birds, and reptiles—are all well represented in the National Zoo, the collection of mammals being especially fine. Among the favorites with visitors are the elephants, of which the Park has two, one from Sumatra and one from Africa. The children particularly are fascinated by these interesting creatures, which seem to them enormous. The African elephants grow to the greatest size, the largest of which there is a reliable record measuring eleven feet six and one-half inches. One of the most striking animals exhibited is the handsome Grévy's zebra, a close relative of the horse. The sharply contrasting stripes which characterize this animal and which at first glance would seem to make it most conspicuous, recall the protective value of the vivid patterns used in camouflaging ships in wartime. This type of camouflage is known as obliterative shading. The Park has a number of zebras, the first example of which was presented to President Roosevelt by Emperor Menelik of Abyssinia. Among the largest of living mammals are the rhinoceros and hippopotamus. The male hippo shown is rather a bad-tempered beast, and in spite of his great bulk can turn and charge with remarkable speed, making him a troublesome pet.

A number of animals of the camel tribe are shown, including the Bactrian, or two-humped, camel; the dromedary, with a single hump; several varieties of the llama, a native of South America; and the vicuña. Among the most attractive of the Park's inhabitants are the deer herds, of which there are no less than fifteen different species, both American and foreign. These are kept in large paddocks with the weeds and other natural features left intact, so that these beautiful and interesting creatures appear to the visitor just as they do in a wild state.

Other ungulates, or hoofed animals, shown are the antelopes; wild goats and sheep; the musk-ox, a native of the Barren Grounds of the Arctic Circle; and the bison and yak and their kindred.

Another distinct division of mammals is the order known as Primates, which includes apes, monkeys, lemurs, and man. The first three of this order are well represented at the Park, and it is a strange fact that not long ago, a man whose name we will not introduce, proposed to complete the representation of the order by offering to exhibit himself in a cage at the Zoo beside the great apes. Among the numerous species of apes and monkeys shown, the greatest attraction to visitors is the chimpanzee. "Soko," a favorite at the Zoo some years ago, was taught when young by the keepers to take his meals seated at a table. This was continued for several years to the great delight of the children, but finally Soko grew so large and powerful that it was no longer safe to trust him at close range, and his "civilization" was discontinued.

Other particularly interesting mammals at the Park include the lions, tigers, leopards, lynxes, and others of the cat family; the wolves and foxes; the bears, of which thirteen different species are shown, including the rare glacier bear of Alaska, and the famous grizzly bear, whose reputation for great strength and ferocity is recorded in many a tale of adventure in the pioneer days of the West.

Other groups are the seals and sea-lions, the latter being particularly attractive to visitors on account of their wonderful swimming powers. There is always a crowd around the sea-lion pond at feeding time, for it is an amusing sight to see these great creatures maneuver themselves so rapidly that the fish thrown to them by the keeper scarcely ever reach the water. Among the pouched mammals, or marsupials, the young are brought forth at a much earlier stage of development than with other animals, and remain for some weeks in the abdominal

pouch of the mother before beginning their active life. Of this group, the National Zoo contains several species of kangaroo, the phalanger of Australia, the Tasmanian devil, and the familiar opossum.

The birds constitute the second class of animals exhibited at the Zoo, and these are fully as great an attraction to visitors as the mammals. Birds are shown to best advantage in various ways; the smaller birds are in separate enclosures in the bird house; there is a large flight cage, of sufficient size to include several trees, where the larger birds are given space to fly about; and a series of ponds provide a natural habitat for the waterfowl. These last form a particularly attractive feature, and are reserved for ducks, geese, and swans of North America. It is planned to show here eventually as many as possible of the sixty-seven species known to occur in America.

The largest birds now in existence are the ostriches, of which three forms are contained in the National Zoological Park. A full-grown male ostrich will sometimes reach a height of eight feet and over. The beautiful black-and-white plumage of the South African ostriches is of great commercial importance, and these birds have been reared on farms in the southwestern United States for their feathers. The wings of ostriches are not sufficiently developed to enable them to fly, but they are extremely rapid runners, and upon occasion can defend themselves effectively with their beaks and powerful feet.

The stork, which legend states brings the new arrivals to our homes, is represented at the Zoo by several individuals. Not long ago a bouncing baby hippopotamus weighing something over forty pounds was born at the Zoo, and a large stork in excellent condition died the next day though these two facts may have no connection! A number of relatives of the stork are shown in the Park, including herons, flamingos, pelicans, ibises, and cormo-

rants. The cormorants are shown in the great flight cage, where they make themselves thoroughly at home, building nests in the trees and rearing young regularly. They seem to be entirely contented with their quarters, for one which escaped and stayed away for more than twenty-four hours, was found the next day waiting patiently at the door for the keeper to let him in again.

A number of species of eagles are kept in the large flight cage, including several examples of the national bird of America, the bald eagle, of which the largest and most handsome specimens come from the Northwest, particularly from Alaska. Among the foreign birds of this group shown in the same cage are the bearded vulture, or lammergeier, of Europe and Asia, where it is reputed to be a vicious and powerful creature; the wedge-tailed eagle of Australia; and the griffon vultures, which become so dangerous during the spring months that they must be taken from the cage to prevent injury to the other birds. In and near the bird house there has been shown the harpy eagle, which attains a considerable age, one individual having lived there for over eighteen years; and the peculiar secretary bird of Africa. The California condor, which has been brought near extermination by the ranchers of the region, because it is known to kill domestic animals, occupies an outdoor cage.

Another interesting bird of a different group which is also rapidly approaching extermination is the great whooping crane, a beautiful large white bird with some black parts, which though formerly abundant throughout the central northern United States and Canada, is now extremely rare. The gulls and terns are represented in the Park chiefly by several species of gulls, including the herring gull so familiar to all those who frequent our northern seaside resorts, and the great black-backed gull, which must be kept either with large birds such as geese and swans or in separate enclosures because of its destructiveness to small birds. Belonging to a neighboring group are

the doves and pigeons, of which the Park has many representatives. The most striking of these is the very large crowned pigeon of New Guinea, which sometimes measures nearly three feet in length. In addition to its beautiful coloration, it is adorned with a spectacular crest resembling a large fan.

A group of birds which is familiar to all, and which is very fully represented in the National Zoo, is the parrot tribe. There are known to exist over five hundred distinct species of these birds both in America and in the Old World. The most common is the type known as the Amazon which occurs in South and Central America. This group, which alone contains nearly fifty species, includes the parrots most commonly kept as pets, which are famed for their talking prowess. A very different member of the parrot family shown in the Park is the large mountain parrot, or kea, of New Zealand, which has acquired the habit of killing sheep by alighting on their backs and stabbing them with its sharp beak. The bird is for this reason relentlessly pursued by ranchers and is rapidly being exterminated.

Among other showy species the Park has the giant kingfisher, known also as the laughing jackass on account of a loud cackling cry which has a startling resemblance to a laugh; the great horned owl, one of the largest birds of prey in America; the great snowy owl of the Far North; and the brilliantly colored toucans of the Tropics.

The order of birds known as perching birds, of which the sparrow is the commonest member, contains more than one-half of all known species of birds. Many of these species are exhibited in the Bird House at the Park, some of the cages containing a large number of varieties grouped together.

In all of the various orders of birds the National Zoological Park has more than three hundred species, represented by well over a thousand individuals, and on account of their beauty, their diversified habits, or their strange

appearance, the birds form one of the strongest attractions for visitors to the Park, particularly since the completion of a new bird house in which they are more adequately shown than in the old structure.

The third and last great division of animal life at present represented in numbers in the Zoo is the class of reptiles, including turtles, crocodiles and alligators, and snakes and lizards. While few people find anything beautiful about these "cold-blooded" animals, yet there is a fascination in a close look at a gigantic boa-constrictor or a poisonous copperhead, and there is always a crowd about the cages containing the snakes. The American snakes shown include several species of the dangerous "rattler," the largest of which is the famous diamond-back which in the southern States reaches a length of eight or nine feet. The bite of these larger forms is especially severe, and there is some probability of death from their poisoning. Two other dangerous snakes are the copperhead and the moccasin, which are particularly dangerous because they have no warning sound to indicate their presence. The harmless snakes of this country are represented by specimens of the black snake, king snake, garter snake, water snake, bull snake, and several others.

One of the special attractions among the reptiles in the Park is the South American anaconda, which reaches the greatest size of all American snakes. There are authentic records of snakes of this species of over twenty feet in length. Its normal habitat is the water, but strangely enough it is almost equally at home in the trees. The anaconda presented to the Park by the governor of Pará, Brazil, in 1899, died in 1927, having been in the collection for twenty-eight years. The largest snake recorded is a native of India, and is known to science as *Python reticulatus*. These attain a length of over thirty feet, and the National Zoo has a specimen of this king of snakes which measures twenty-five feet in length.

Another order of the reptile class includes the turtles

and tortoises. These vary in size from the little box turtle so familiar in our eastern States to the giant tortoise of the Galápagos Islands, which reaches a length of nearly four feet. These great slow-moving creatures, which were formerly very abundant on the Galápagos and other islands of the Indian and Pacific Oceans, have been very nearly exterminated through ruthless hunting. They are credited with being the longest-lived animals on the earth.

The third order of reptiles in the Park collections consists of the alligators and crocodiles. The alligator was formerly very abundant in the southern part of the United States, especially in Florida, but has been persistently hunted so that in many sections where they were formerly common an alligator is now a rare sight. The Park has a large number of these strange creatures, which attract great popular interest.

The best test of the condition of a zoological park is the regular breeding of young by the various animals. The National Zoo has been highly successful in this respect, and great numbers of deer, bison, lions, tigers, bears, and many other animals have been born in the Park and raised to be healthy adults. The keepers are always proud of these new arrivals, and the little animals are the greatest attraction of all to visitors. With the announcement in the paper that there has been an addition to the bear family or the tiger tribe, great throngs of people will visit the Park on the following day eager to see the awkward little fellows.

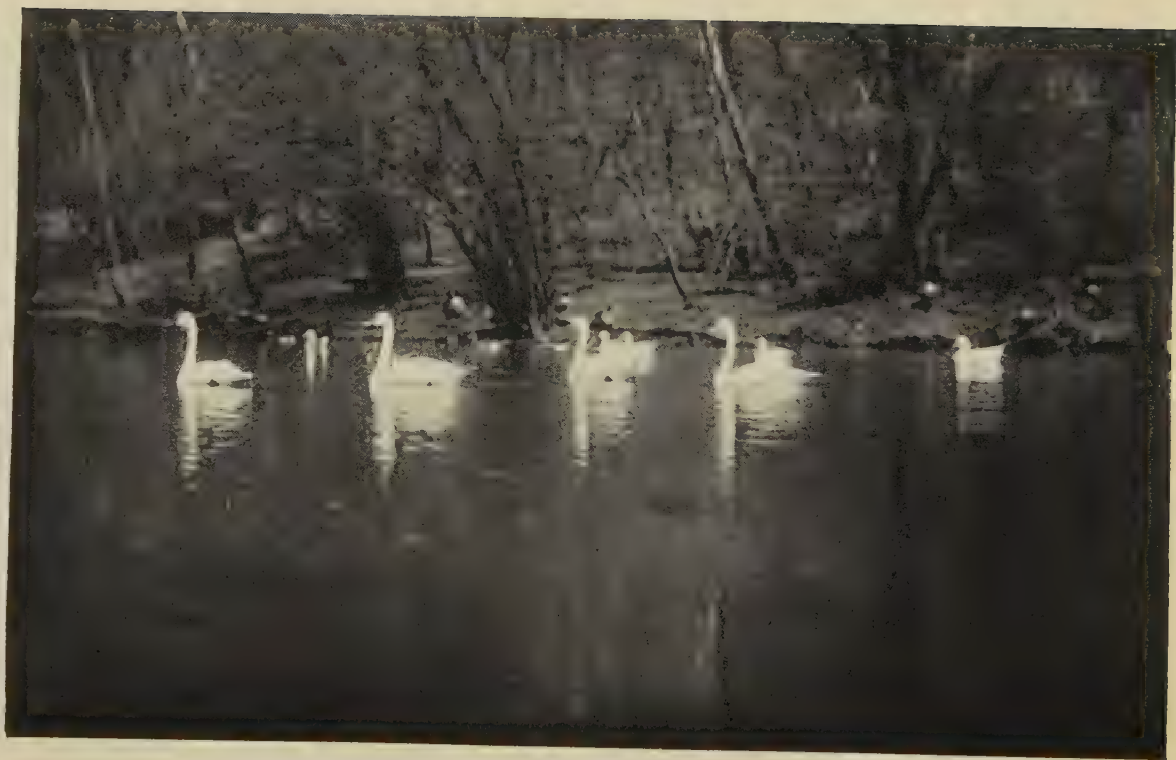
One of the questions most frequently asked by visitors is "Where do all the animals come from?" This is easily answered, for by far the majority of all animals seen in zoological gardens come from a single source—the regular animal importers. These concerns have headquarters, with storage facilities for live creatures, at the large seaports in this country, and their agents scour the out-of-the-way corners of the earth for desirable animals. These

they purchase from natives and from small local dealers in various countries, assemble them at a shipping center and accompany them on their way to the United States, where they are distributed to zoos, animal dealers, and circuses. The National Zoological Park is especially fortunate in having additional sources of supply—namely the gifts of governments and individuals to the President or other high officials, and the collections of animals secured through special efforts of American consuls in foreign lands and through the activities of other bureaus of the Government interested in animal life.

In March, 1926, with its destination the African jungle, an expedition for the collecting of live wild animals, rivaling in results the famous expeditions of the Egyptian kings, was sent out by the Smithsonian Institution. The expedition was financed by Mr. Walter P. Chrysler. Tanganyika was chosen as being one of the best localities in which to make a representative collection of the game animals of East Africa. The party consisted of four members: Dr. W. M. Mann, Director of the Zoological Park and leader of the expedition; Mr. Stephen Haweis, artist and amateur naturalist; Mr. F. G. Carnochan, of New York City; and Mr. Arthur Loveridge, of the Museum of Comparative Zoology of Harvard University. Headquarters were made at Dodoma, about 250 miles inland from Dar-es-Salaam, Tanganyika. The country there is hot and dry, rolling, and dotted with rocky kopjes, and reminds one strongly of parts of southern Arizona. The natives belong to the Wagogo tribe, and are a pastoral and agricultural people. Not being a hunting tribe, they brought in few large specimens, but were very useful in collecting small things. In this locality were secured five blue monkeys, three golden baboons, and a pair of elephant shrews. Mr. Carnochan worked in the Tabora district, where he lived among the Manumwezi tribe, experts in snake catching, and his division of the expedition succeeded in forming a considerable collection of snakes and

Mouflon family in the National Zoological Park. Father, mother, year-old lamb, and 2-weeks-old lamb

PLATE 33



Trumpeter and whistling swans, National Zoological Park

several interesting mammals, including a female eland and a rare caracal.

On Lake Manyara were captured three white-bearded gnu which were brought safely to Washington. As the party marched along the shore of the lake, the herds of gnu would run in front of them, back and forth the whole day, and when evening came they were very tired and attempted to cut back between the party and the lake. The porters dropped their loads and headed them off, and getting into the shallow lake, mixed with the herd. When the splashing had died down, little groups of natives brought back the calves which they had seized. These became tame very quickly, fed readily, and were thoroughly satisfactory animals to catch and keep.

It was the great wish of Doctor Mann to capture some specimens of rhinoceros. Mando, the best native guide, told of a district, the Ja-aida swamp country, in which he said there were "Faro mingi sana" (very many rhinos), and what he said was found to be true. Altogether twenty-two rhinos were seen, and once the safari was charged on the march. Four times at night rhinos charged through the camp, but in all of these encounters, not a single young specimen was located. Five different times the hunters crawled into the scrub thirty or forty feet from a rhino to see if it had young and were disappointed each time. Rhinos are easily located by means of the tick birds, which make a loud twittering at the approach of any suspicious object to the rhino on which they are clustered for the purpose of eating the ticks so abundant on its body. Theoretically they serve a useful purpose to the rhino by warning him of his enemies. Actually they led the hunters to where the rhino was lying.

With two native sultans, Chanzi and Chaduma, bringing with them about 500 natives, was made the most successful trip of the expedition. Some of the boys from a mountain nearby were experienced in netting game. They

made a coarse seine of native rope in sections about five feet high and fifteen feet long. These were placed in a row, until they made about 1,000 feet of native fence, one boy hiding behind each section. The two groups of natives would then join in a circle about a mile in circumference and close in toward the net. The object was to drive game into the net, but nine times out of ten the animals would break through the line. Occasionally, however, they came straight on. One day a herd of over fifty impalla was surrounded. This is the most graceful antelope in Africa and a great leaper. Most of them sailed right over the net, but five fell short and were caught. Fortune favored the party as far as impalla were concerned, for it is one of the most delicate animals to handle, and yet all of those captured reached Boston alive and in good condition. Wart-hogs were captured in the same way and a troop of four were added to the collection.

Besides rhinos, giraffes were also particularly sought for by the expedition. They were abundant about Tula but not easy to catch without horses. Many times the party tried to drive them into the nets, but a herd of giraffes runs in a file led by the biggest bull, and he apparently enjoyed kicking the nets into the air as high as possible. Once the party succeeded in separating from the herd a calf about eight and a half feet tall. One of the natives grabbed it by the tail, another by the neck and threw it. It was carried into camp on a native bed heaped high with grass and put in a room of a Kafir native-built house. It became tame and fed readily on milk and mimosa leaves, but unfortunately the animal was later attacked by pneumonia and died very suddenly. However, the Sudan Government was so obliging as to dispose of a pair of young giraffes to the expedition which, despite the delicacy of these animals in captivity, were carried safely to Washington and for a considerable time were favorite objects at the National Zoological Park.

The Chrysler expedition nearly doubled the population of the Zoo and its results were exceedingly valuable from the standpoint of the scientist, the student of natural history, and the visitor. The new animals included giraffes, many monkeys, a leopard, several specimens of the antelope family, tortoises, parrots, a shoebill stork, and a host of others, totaling nearly 1,600 specimens, large and small.

That so large a proportion of the captured animals came safely through the very long ocean trip of forty-five days was due to the extreme devotion of the members of the party, who lost much sleep in watching them. Two Tanganyika natives, James and Saida, adepts in the care of captured animals, were brought along to help, and, as may well be imagined, they enjoyed their brief stay in the United States exceedingly. They were themselves great curiosities and favorites at the Zoo, and were not at all afraid or bashful at the attention paid them by visitors.

A brief extract from a letter from Doctor Mann shows vividly the excitement of a great game-capturing drive in East Africa:

"I want to get that giraffe home safely more than anything else I can think of. From now on I shall keep right with him all the time. In order not to arrive too late in the season I shall have to start home very soon now.

"Incidental to the giraffe drive there was much excitement. Once we got a whole troop of wart-hogs into the circle and drove them into the net. The big ones got through, but we caught some of the half-grown ones and got them into camp where they are thriving and keeping us busy trying to get enough food for them. Once a half-grown one got tangled in the net. Goss jumped on it, and at the same time one that we had not seen, a huge full-grown one, hit the net, wrapping itself and Goss and the young one all up in a struggling mass together. It was exciting for a moment, but all three got out unhurt. As wart-hogs can give terrible gashes with their tusks,

my heart was in my mouth. I could not shoot the big one as in the struggling mass composed of Goss and the big and little wart-hog, surrounded and obscured by the net, it was impossible to tell which was which. One of our natives did get a bad bump and a gash from a boar.

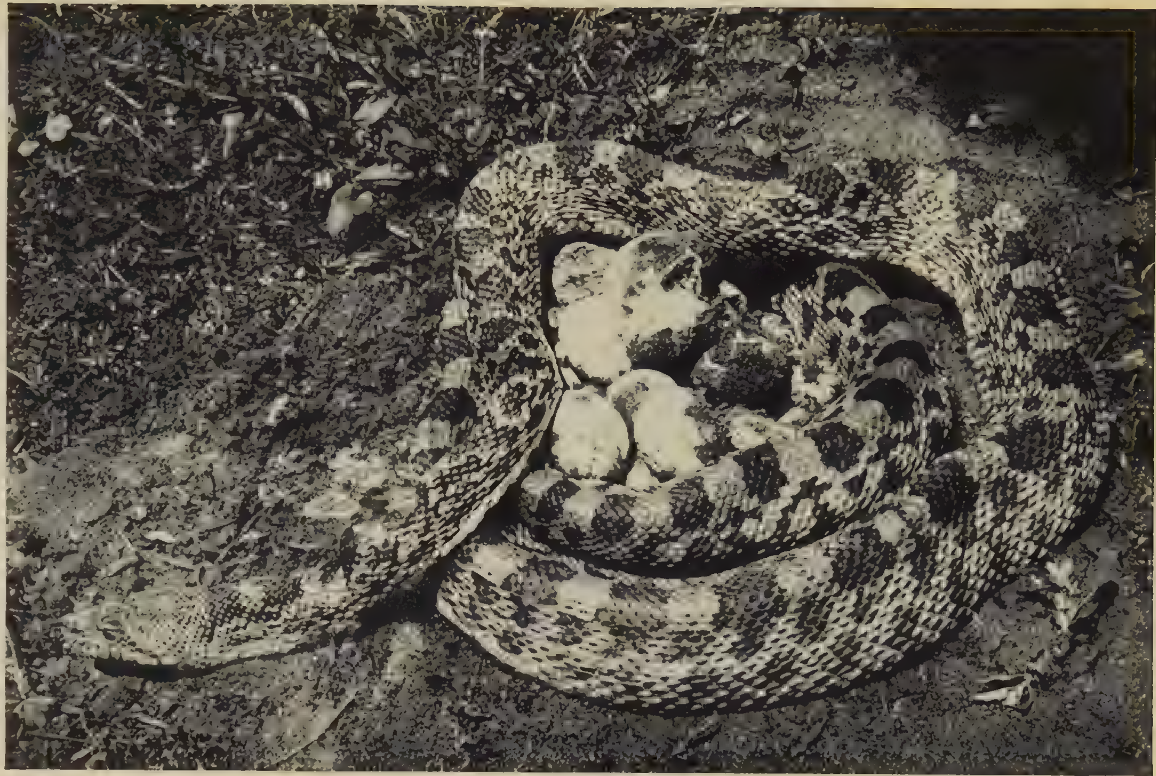
"One evening we circled a field of tall cane to see what would come out of it. For a few moments the drive went along all right. Then a lion grunted right in the center of our circle. You should have seen the boys cluster in black knots and wave their spears and shout mightily. We did not blame them, for walking in a regular line ten feet from the nearest man and in grass more than two feet higher than your head and armed only with a spear makes you suddenly feel very lonely when you hear a lion.

"A near tragedy happened at the same time. A buffalo charged one of the men, hit him square with the tip of the horn, knocking him over, and dashed away. Luckily the tip of the horn struck a rib which it did not break. Half an inch higher or lower would have been fatal. That would have been a sad thing as so far there have been no casualties among the boys.

"Excepting for my failure with the rhino the trip is a great success so far as the collection is concerned. New things worthy of mention since my last letter are fennecs, two fine koodoo calves, more leopards and hyenas, a fourteen-foot python, and a hunting dog. The hunting dog was an animal I especially wanted. It is a beautiful animal. I have seen them in the field twice. They hunt in zigzags and scour the country for game. They are a scourge to the antelopes. The ones we saw were in tall grass and kept jumping up and looking at us and barking hoarsely."

There are many difficult problems connected with the management of a large zoological park which are not apparent to the visitor. To feed a city of several thousand

PLATE 34



Harmless American bull snake with eggs, National Zoological Park

animals is no small task, and enormous quantities of supplies are required every month. The staple requirements are hay, corn, oats, stale bread, meat, fish, and vegetables, while many other articles are required by individual species, such as rice, yeast, sweet potatoes, bananas, and eggs. Careful records of each animal must be kept, showing its age, history, illnesses, and other necessary information. Regarding the important matter of sickness among the inhabitants of the Zoo, Mr. Hollister, former Superintendent, has written:

"In every community of 1,600 or 1,700 people, some one is pretty likely to be ill. It is so in the Zoo. Every day each animal is carefully observed and any signs of illness are promptly reported to the head keeper. Most of the ailments are slight, and prompt recovery follows proper attention.

"If necessary, the animal is removed to the hospital building for isolation and better facilities for treatment. Always there are deaths, but the rate is very low, and, as mentioned before, many species are kept long beyond the usual period of life for a wild animal. Old age is protected and prolonged in the Zoo; in the wild state all animals past their prime are liable to tragic ends."

The National Zoo has faithfully carried out the intentions of Congress, who ordered it to be established "for the advancement of science and the instruction and recreation of the people." Every year many classes of students visit the collections and, under the guidance of their teachers, are enabled to receive with the living animals before them the finest kind of instruction in natural history. Art students are frequently seen in the Park making studies of the animals, and to taxidermists such a study is essential in preparing animals for mounting. Much is learned regarding the anatomy and diseases of animals from the thorough examination made of those which die in the Park. The public approval of the Zoo is amply shown by the fact that over two million

visitors now enter its gates every year. These include not only residents of the District of Columbia, but hundreds of thousands of tourists from every State in the Union, who have, with those living nearby, an equal interest and pride in the National Zoological Park.

CHAPTER VII

PRESERVING THE VANISHING STORY OF THE INDIANS

We owe the success of the Bureau of American Ethnology largely to that daring explorer and eminent scientist and administrator, Major John Wesley Powell. He enlisted as a private in the Union Army in the Civil War and rapidly rose to the rank of major of artillery. At the battle of Shiloh, in which he served with great distinction and gallantry, at the moment of raising his right hand as a signal to fire, a rifle bullet shattered his wrist. With the nonaseptic surgery of that day, it became necessary to amputate at the elbow, so that the active life of an explorer, in which he so greatly distinguished himself, was carried on with the handicap of the loss of his right arm. After the war, Major Powell and a Confederate officer named Col. C. E. Hooker, who had lost his left arm at Shiloh, became friends, and for many years, when either bought a pair of gloves he sent the unused glove to the other.

Hardly was the war over before Powell began his pioneer explorations, geological studies, and observations of Indian life in the Far West. In his geological expeditions in Colorado and the Southwest, Powell conceived the daring idea of descending the Grand Canyon of the Colorado River in boats, in order to explore its course and the geological phenomena of this extraordinary region.

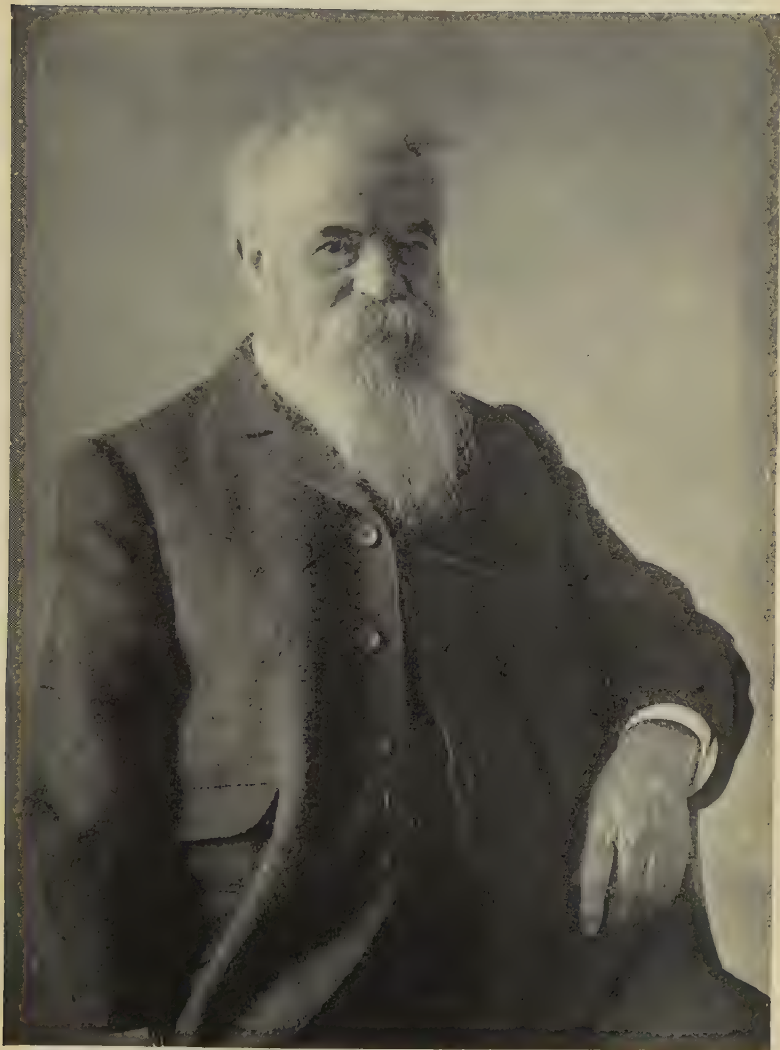
The great danger of the undertaking no one realized better than Powell, for he knew that from the starting point on the Green River to where the Colorado emerges from its canyon, there is a vertical drop of over 6,000 feet, which meant many rapids and possibly great falls. Furthermore, there was high probability that on arriving at rapids too swift for boats to navigate, the canyon walls might also be so sheer as to prevent portage, and this combination could mean but one thing—death for the whole party.

Nevertheless, Powell, after weighing all of the circumstances, came to the conclusion that the chances of success and the importance of the work warranted the great risk involved, and after many months of study of the problem and of the surrounding regions, preparations for the expedition were begun. The strongest possible boats were built, each containing water-tight compartments at bow and stern, and the surveying and other instruments and the provisions were divided and distributed among all the boats, so that a disaster to one boat would not endanger the whole expedition. Regarding the expedition itself, I will quote the brief account given at a commemorative meeting for Major Powell by Dr. C. R. Van Hise:

"On May 24, 1869, the party of ten men in four boats starts on its perilous journey. The difficulties to be overcome in the canyons of the Green and the Colorado are found sufficient to try Powell to the utmost. Wherever the rivers traverse the hard rocks there are many rapids and falls to be run or portaged. The boats are frequently swamped and the provisions wetted again and again, so that a large part of them are spoiled.

"Early in the expedition one of the boats is completely wrecked. Some days later the courage of one of the men fails, and he leaves the party. But the nature of the difficulties and the way to overcome them are gradually learned; and then all goes well until the Grand Canyon is reached. But here the river turns into the granite, a

PLATE 35



Major John Wesley Powell, founder and first Chief of the Bureau of American Ethnology under the Smithsonian Institution

Group of Paiute Indians photographed by Major Powell's Colorado Expedition in 1873

harder rock than had been before encountered. Rapids and falls follow one another in quick succession. At various places it seems all but impossible to run the rapids or portage the falls. But the granite area is finally cleared in safety, and in the sedimentary rocks below rapid progress is made.

"But again the river turns into the granite; and when a set of bad rapids and falls are approached the spirits of three of the men fail. They have not the sustained courage which rises as difficulties and dangers increase. They decide to climb out of the canyon rather than to continue. They remonstrate with Powell and the remainder of his party, trying to prevent them from continuing a course which seems to them to lead to certain destruction. A second boat is abandoned, and with this boat the barometers and the fossils and minerals collected. The scanty, almost spoiled provisions and the maps and notes—records of the expedition—only are retained. Probably but few fully appreciate the desperate frame of mind in which a leader of Powell's scientific instinct must be before he takes such a step as this.

"With deep misgivings, the two boats and the remainder of the party, six in number, push on. Early in the morning the rapids before them are successfully passed, but greater difficulties are found below. In the afternoon a set of rapids and falls is approached which it seems impossible to portage. There is nothing to do but to attempt to run them, with the certainty that the boats will be swamped, but with the hope that the air-tight compartments will bring them to the surface below the falls. Such a course would seem rash to the border of madness, had not previous experiences shown that it was possible. Both boats run over the falls, and are swamped as expected, but the men cling to them and emerge in safety in the pool below. The very next day they run out of the granite, and out of the Grand Canyon. The expedition has achieved success."

I also quote a bit from Powell's own simple story:

"It is not easy to describe the labor of such navigation. We must prevent the waves from dashing the boats against the cliffs. Sometimes, where the river is swift, we must put a bight of rope about a rock, to prevent her being snatched from us by a wave; but where the plunge is too great, or the chute too swift, we must let her leap, and catch her below, or the undertow will drag her under the falling water, and she sinks. Where we wish to run her out a little way from shore, through a channel between rocks, we first throw in little sticks of driftwood, and watch their course, to see where we must steer, so that she will pass the channel in safety. And so we hold, and let go, and pull, and lift, and ward, among rocks, around rocks, and over rocks.

"And now, we go on through this solemn, mysterious way. The river is very deep, the canyon very narrow, and still obstructed, so that there is no steady flow of the stream; but the waters wheel, and roll, and boil, and we are scarcely able to determine where we can go. Now, the boat is carried to the right, perhaps close to the wall; again, she is shot into the stream, and perhaps is dragged over to the outer side, where, caught in a whirlpool, she spins about. We can neither land nor run as we please. The boats are entirely unmanageable; no order in their running can be preserved; now one, now another, is ahead, each crew laboring for its own preservation. In such a place we come to another rapid. Two of the boats run it perforce. One succeeds in landing, but there is no foothold by which to make a portage, and she is pushed out again into the stream. The next minute a great reflex wave fills the open compartment; she is water-logged, and drifts unmanageable. Breaker after breaker rolls over her, and one capsizes her. The men are thrown out; but they cling to the boat, and she drifts down some distance, alongside of us, and we are able to catch her. She is soon bailed out, and the men are aboard once

PLATE 37

Sioux Indian Chief, Apeyohantanka, or Big Man. Born 1839. Photographed by the Bureau of American Ethnology in 1913

more; but the oars are lost, so a pair from the *Emma Dean* is spared. Then for two miles we find smooth water.

"Clouds are playing in the canyon today. Sometimes they roll down in great masses, filling the gorge with gloom; sometimes they hang above, from wall to wall, and cover the canyon with a roof of impending storm; and we can peer long distances up and down this canyon corridor, with its cloud roof overhead, its walls of black granite, and its river bright with the sheen of broken waters. Then, a gust of wind sweeps down a side gulch, and, making a rift in the clouds, reveals the blue heavens, and a stream of sunlight pours in. Then, the clouds drift away into the distance, and hang around crags, and peaks, and pinnacles, and towers, and walls, and cover them with a mantle, that lifts from time to time, and sets them all in sharp relief. Then, baby clouds creep out of side canyons, glide around points, and creep back again, into more distant gorges. Then, clouds, set in strata, across the canyon, with intervening vista views, to cliffs and rocks beyond. The clouds are children of the heavens, and when they play among the rocks, they lift them to the region above.

"It rains! Rapidly little rills are formed above, and these soon grow into brooks, and the brooks grow into creeks, and tumble over the walls in innumerable cascades, adding their wild music to the roar of the river. When the rain ceases, the rills, brooks, and creeks run dry. The waters that fall during a rain, on these steep rocks, are gathered at once into the river; they could scarcely be poured in more suddenly, if some vast spout ran from the clouds to the stream itself. When a storm bursts over the canyon, a side gulch is dangerous, for a sudden flood may come, and the inpouring waters will raise the river, so as to hide the rocks before your eyes.

"Early in the afternoon we discover a stream entering from the north, a clear, beautiful creek, coming down

through a gorgeous red canyon. We land, and camp on a sand beach, above its mouth, under a great, overspreading tree, with willow-shaped leaves."

The year following his daring passage of the Grand Canyon, Powell made plans to explore it more thoroughly. In preparing depots of supply he fell in with Indians who told him what had happened to his white companions. He tells as follows of evenings in camp:

"After supper we put some cedar boughs on the fire, the dusky villagers sit around, and we have a smoke and a talk. I explain the object of my visit, and assure them of my friendly intentions. . . .

"Having finished our business for the evening, I ask if there is a *tu-gwi'-na-gunt* in camp: that is, if there is any person present who is skilled in relating their mythology. *Chu-ar'-ru-um-peak* says *To-mor'-ro-un-ti-kai*, the chief of these Indians, is a very noted man for his skill in this matter; but they both object, by saying that the season for *tu-gwi'-nai* has not yet arrived. But I had anticipated this, and soon some members of the party come with pipes and tobacco, a large kettle of coffee, and a tray of biscuits, and, after sundry ceremonies of pipe lighting and smoking, we all feast, and, warmed up by this, to them, unusual good living, it is decided that the night shall be spent in relating mythology. I ask *To-mor'-ro-un-ti-kai* to tell us about the *So'-kus-Wai'-un-ats*, or One Two Boys, and to this he agrees. . . .

"It is long after midnight when the performance is ended. The story itself was interesting, though I had heard it many times before; but never, perhaps, under circumstances more effective. Stretched beneath tall somber pines; a great camp fire, and by the fire, men, old, wrinkled, and ugly; deformed, blear-eyed, wry-faced women; lithe, stately young men; pretty but simpering maidens; naked children, all intently listening, or laughing and talking by times, their strange faces and dusky forms lit up with the glare of the pine-knot fire. All the cir-

cumstances conspired to make it a scene strange and weird. One old man, the sorcerer or medicine-man of the tribe, peculiarly impressed me. Now and then he would interrupt the play for the purpose of correcting the speakers, or impressing the moral of the story with a strange dignity and impressiveness that seemed to pass to the very border of the ludicrous; yet at no time did it make me smile. . . .

"There is yet time for an hour or two's sleep. I take *Chu-ar'-ru-um-peak* to one side for a talk. The three men who left us in the canyon last year found their way up the lateral gorge, by which they went into the *Shi'-vwits* Mountains, lying west of us, where they met with the Indians, and camped with them one or two nights, and were finally killed. I am anxious to learn the circumstances, and as the people of the tribe who committed the deed live but a little way from and are intimate with these people, I ask *Chu-ar'-ru-um-peak* to make inquiry for me. Then we go to bed.

* * * * * *

"This evening, the *Shi'-vwits*, for whom we have sent, come in, and after supper we hold a long council. A blazing fire is built, and around this we sit—the Indians living here, the *Shi'-vwits*, Jacob Hamblin, and myself. This man, Hamblin, speaks their language well, and has a great influence over all the Indians in the region round about. He is a silent, reserved man, and when he speaks, it is in a slow, quiet way that inspires great awe. His talk is so low that they must listen attentively to hear, and they sit around him in deathlike silence. When he finishes a measured sentence, the chief repeats it, and they all give a solemn grunt. But first I fill my pipe, light it, and take a few whiffs, then pass it to Hamblin; he smokes, and gives it to the man next, and so it goes around. When it has passed the chief, he takes out his own pipe, fills, and lights it, and passes it around after

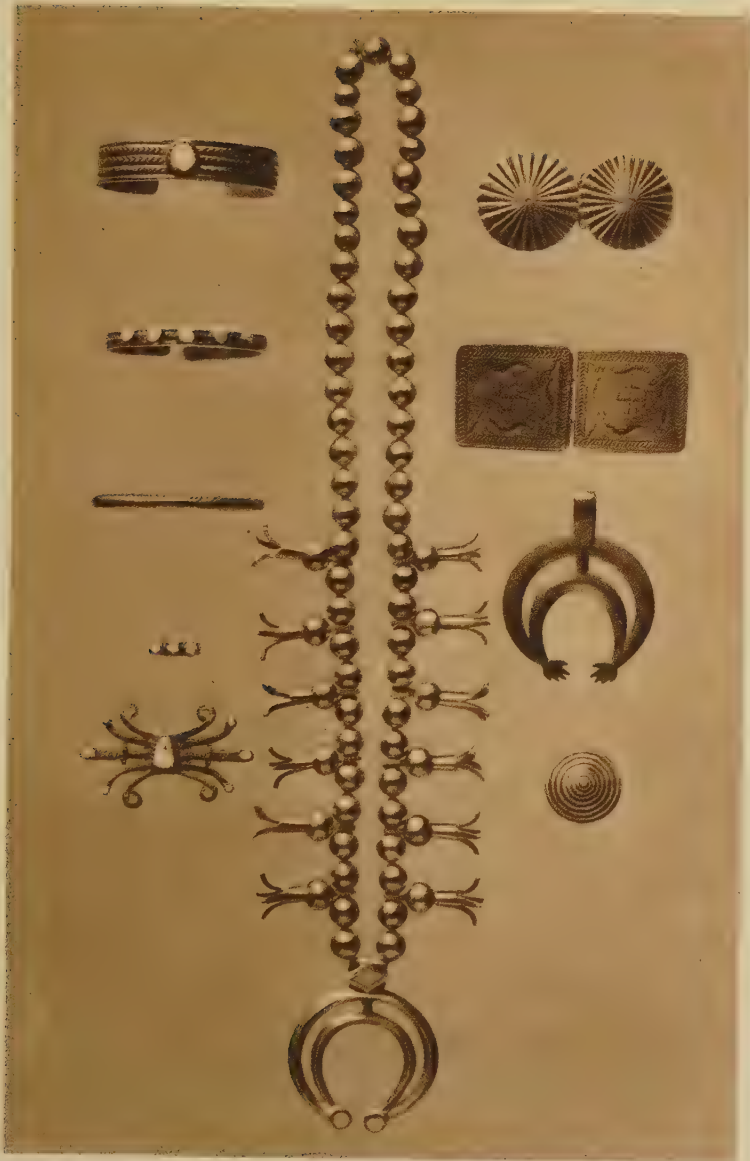
mine. I can smoke my own pipe in turn, but, when the Indian pipe comes around, I am nonplussed. It has a large stem, which has, at some time, been broken, and now there is buckskin rag wound around it, and tied with sinew, so that the end of the stem is a huge mouthful, and looks like the burying ground of old dead spittle, venerable for a century. To gain time, I refill it, then engage in very earnest conversation, and, all unawares, I pass it to my neighbor unlighted.

"I tell the Indians that I wish to spend some months in their country during the coming year, and that I would like them to treat me as a friend. I do not wish to trade; do not want their lands. Heretofore I have found it very difficult to make the natives understand my object, but the gravity of the Mormon missionary helps me much. I tell them that all the great and good white men are anxious to know very many things; that they spend much time in learning, and that the greatest man is he who knows the most. They want to know all about the mountains and the valleys, the rivers and the canyons, the beasts, and birds, and snakes. Then I tell them of many Indian tribes, and where they live; of the European nations; of the Chinese, of Africans, and all the strange things about them that come to my mind. I tell them of the ocean, of great rivers and high mountains, of strange beasts and birds. At last I tell them I wish to learn about their canyons and mountains, and about themselves, to tell other men at home; and that I want to take pictures of everything, and show them to my friends. All this occupied much time, and the matter and manner made a deep impression.

"Then their chief replies: 'Your talk is good, and we believe what you say. We believe in Jacob, and look upon you as a father. When you are hungry, you may have our game. You may gather our sweet fruits. We will give you food when you come to our land. We will show you the springs, and you may drink; the water is

PLATE 38

Silver ornaments made by Navaho Indian artists. Now in National Museum



good. We will be friends, and when you come we will be glad. We will tell the Indians who live on the other side of the great river that we have seen *Ka'-pu-rats*, and he is the Indians' friend. We will tell them he is Jacob's friend. We are very poor. Look at our women and children; they are naked. We have no horses; we climb the rocks, and our feet are sore. We live among rocks, and they yield little food and many thorns. When the cold moons come, our children are hungry. We have not much to give; you must not think us mean. You are wise; we have heard you tell strange things. We are ignorant. Last year we killed three white men. Bad men said they were our enemies. They told great lies. We thought them true. We were mad. It made us big fools. We are very sorry. Do not think of them; it is done; let us be friends. We are ignorant—like little children in understanding compared with you. When we do wrong, do not get mad, and be like children too.

" 'When white men kill our people, we kill them. Then they kill more of us. It is not good. We hear that the white men are a great number. When they stop killing us, there will be no Indian left to bury the dead. We love our country; we know not other lands. We hear that other lands are better; we do not know. The pines sing, and we are glad. Our children play in the warm sand; we hear them sing, and are glad. The seeds ripen, and we have to eat, and we are glad. We do not want their good lands; we want our rocks, and the great mountains where our fathers lived. We are very poor; we are very ignorant; but we are very honest. You have horses, and many things. You are very wise; you have a good heart. We will be friends. Nothing more have I to say.'

"*Ka'-pu-rats* is the name by which I am known among the Utes and Shoshones, meaning 'arm off.' There was much more repetition than I have given, and much emphasis. After this a few presents were given, we shook hands, and the council broke up."

In 1871 Congress, realizing the value of the scientific exploration of the western lands, made an appropriation for "The United States Geographical and Geological Survey of the Rocky Mountain Region," and placed Major Powell in charge. In carrying on this work, he devoted much attention to the study of the Indians, their customs, arts, and languages, and the collections made were sent on for preservation to the Smithsonian. By 1879 there were four distinct Government surveys being carried on in the West, and at this time Congress deemed it wise to unite these under the U. S. Geological Survey. At the same time, recognizing the great importance and interest of studying the Indians, provision was also made for continuing the anthropological work under the Smithsonian, and Secretary Baird placed the direction of the new bureau in the capable hands of Major Powell. This was the beginning of the Bureau of American Ethnology, which is still supported by Congressional appropriation although administered by the Smithsonian Institution.

The new Bureau entered at once upon the scientific study of the Indians as a race, and the researches which had been conducted before in a somewhat haphazard manner were now organized by Major Powell in logical sequence and the particular lines of work selected which seemed to require immediate attention. The greatest practical problem involved was the fact that there were then dependent on the United States Government some 300,000 Indians, concerning whom little was known as to their relationship, distribution, characteristics, and needs. This lack of knowledge of the fundamental requirements for intelligent administration of these wards of the Nation was one of the important considerations in establishing the Bureau, and to correct this situation Major Powell at once began the task of locating the various tribes and classifying them, so that it might be possible to:

Animal designs on ancient Indian pottery from the Mimbres Valley, New Mexico, first described by the Bureau of American Ethnology

A'kwiyā''megu wä'ci'sä'āmāgō'mādtci' ä'wâpA'ci'megudtci'. 'Ō'nipi ne'sugunagA'tenigki', "Ōnī'yätuge wâpA'ge wAni'nawe kīwitAnā''cinAgkwe'," ä''igudtci'. "'Ō' nī'nA wī'nA me'ce'meg ä'inā'cino'wānänni'," ä''inidtci'. 'Ō'nipi wâ'pAnigi nāwA''kwänig ä'pyädtciwīyA'ckināgwA'tenigi negwā'nA'kwA'ki'. Ä'ki'meg ä'sä-'ge''siwādtci'. KAbō'tw ä'nätA'mowādtci mämye'cime''tegōn a'pemā''senigki'. A'nīpyän ä'pApAgwAdtciwäyā''senigki'. Ī'nip ä'säge''siwādtci', mAgwA''kiwAn ä'pegepegedtcäyā''senigki'.

Īnipī'ni mī'cā'm ä'mAmātotA'mowādtci'.

"'Ō' kenA''kumenne'," ä'i'gowādtci'. "MA'ni nemī'cā'menānimā'i kī'mawitA'ci'ā'pi'āpwA'," ä''inādtci mämī'cAmā'gudtci'i'. "Kegeni'-megu," 'ä''inādtci'. Kegeni'meg ä'āpi'ckwi'sA''tōwādtci'. Īnigä-'me'gupi ke''tcin ä'pyämigA'tenigki'. Īni'pīn ī'ni wämī'cā'mitAg īte'p ä'inā'sAmi'gāpādtci'. Ä'kA'nakA'nawidtci': "Neme'cō'me-'setigke', nō'dtci', 'ō', 'aiyō', nō'dtci', mA'kwā'dtci', nō'dtci', 'ō' kī'pe'me'kāpwA', nō'dtci', 'ō', sägi'ī'yägägku', nō'dtci', 'ō', keme'to-'säneni'mwāwAgki', nō'dtci'. MA'kwā'dtcidtcā nō'dtci', wī'peme'-'kaiyägkwe', ī'ni nō'dtci', ä'ci' nō'dtci' nAtawäne'menägke', nō'dtci'. 'Ō' nō'dtci', mA'ni, nō'dtci' 'ō' nō'dtci', nemī''cāmmi', nō'dtci', ī'ni nō'dtci', wä'dtci', nō'dtci', 'ō' me'cki'setō'nAgōwwe', 'ō' nō'dtci', wī'näwu'gwiyägkwe', nō'dtci', ä'peme''kaiyägkwe', nō'dtci'. Ī'ni nō'dtci', wä'dtci', nō'dtci', ä'ci'setō'nAgōwwe', nō'dtci', neme-'cō'me'setigke', nō'dtci'. 'Ō' nō'dtci', täpwäwiketeminō''tawigku', nō'dtci', kīnwāwA'ku'i nō'dtci', kemanetowi'pwA', nō'dtci'. Ī'ni-dtcā'nō'dtci', wä'dtci', nō'dtci', me'cena'nō'dtci', mAmātome'-nAgōwwe', nō'dtci'. Ī'nidtcā' nō'dtci' 'ō', i'citä'ä'gku', nō'dtci', 'ä''ci nō'dtci' 'ō' mAmātome'nAgōwwe', nō'dtci'. Īni'megu nō'dtci', 'i''cawigku', nō'dtci'; wī'pwāwiku'wīnA'sägi'sä'gi'ägkwe', nō'dtci', 'ō' kete'ci'megōpwA', nō'dtci'. Ī'ni nō'dtci', 'ä'cikī'cowā'nenāgwe 'ō' kī'dtci nō'dtci' manetō'wāwAgki', 'ō' nō'dtci', na''ina' aiyō''i pAgi'sā'kwi'menāgwe kīdtcimanetō'wāwAgki'. Īnidtcā'kä' nī'nA wä'-dtci me'ce'na'i mAmātome'nAgōwe, neme'cō'me'setigke'," ä''inādtci'.

Ke'tenA'meg ä'nigaw ä'inānemA'tenigki'. Ä'nenyä'ckwā''senig ī'niy ä'AniwānemA'tenigki'.

'Ō'nipi mämī'cAmā'gudtcinni', "Na'i', kī'peme'cka'wāwAgi mämī-'cAma'wAdtcigki'," ä''inādtci'. "Me'ce'megu tA''sw ä'A'tō'gwä'ig aiyō''i wī'pyä'tōwAgi kägō''i'; nī'kīgä'nopennA'. 'Kī'kīgä'nupwApi',' ī'ni wī'peminādtci'mo'Adtci me'ce'megku', 'aiyō''meg ä'uwīge'-'iyānni',' ä'i'dtci'.

A specimen page of Indian text published by the Bureau of American Ethnology, showing the many unusual diacritical marks necessary

"Assemble them in harmonious groups, based on relationship of blood, language, customs, beliefs, and grades of culture. It was found that within the area with which the Nation has to deal there are spoken some five hundred Indian languages, as distinct from one another as French is from English, and that these languages are grouped in more than fifty linguistic families. It was found, further, that in connection with the differences in language there are many other distinctions requiring attention. Tribes allied in language are often allied also in capacity, habits, tastes, social organization, religion, arts, and industries, and it was plain that a satisfactory investigation of the tribes required a systematic study of all of these conditions. It was not attempted, however, to cover the whole field in detail. When sufficient progress had been made in the classification of the tribes, certain groups were selected as types, and investigations among them were so pursued as to yield results applicable in large measure to all. Up to the present time, much progress has been made, and a deeper insight has been gained into the inner life and character of the native people, and thus, in a large sense, of primitive peoples generally, than had been reached before in the world's history. Many of the results of these researches have already been published and are in the hands of all civilized nations."

In this preliminary work of classification of tribes, languages, and relationships, were laid the foundations of all of the later work of the Bureau, and when it was completed, it then became possible to carry out intensive studies on special phases of Indian life. Besides a regular staff of ethnologists, the Bureau called in the aid of expert collaborators for particular researches, and the work of many of these while connected with the Bureau has brought them international reputation. Among these early collaborators were the Mindeleff brothers, Albert S. Gatschet, Cyrus Thomas, Frank Hamilton Cushing, and Walter J. Hoffman. The early workers as members of

the staff of the Bureau included W. J. McGee, Henshaw, Stevenson, Reynolds, Dorsey, Pilling, Holmes, Hodge, Mooney, and Mrs. Stevenson. The present staff is headed by Matthew W. Stirling, Chief, and includes three anthropologists, three ethnologists, and one archeologist. Special collaborators have included Miss Frances Densmore, D. I. Bushnell, Jr., Gerard Fowke, and others. The work of this scientific staff covers all the various phases of the investigation of the American Indian from prehistoric times down to the present day.

From the early days of America, authentic information regarding the Indians has been eagerly sought for by the public. The romantic history of the race and the frequent appearance of Indians in popular fiction has led to a great demand for more knowledge regarding their customs and manner of living, and this demand the Bureau of American Ethnology has met through its publications and voluminous correspondence. As with the Institution proper and its other branches, the work has been divided into two distinct phases: one, the increase of knowledge, accomplished through field work among the living Indians themselves and on the mounds and cliff dwellings abandoned centuries ago by their ancestors, and through office researches regarding their language and history; the other, the diffusion of this knowledge by means of a series of publications.

The work early grouped itself into four major divisions: first, language, including speech and picture writing, upon which the classification of the various tribes was based; second, the native arts, in their many forms of expression; third, the Indian institutions and organizations; and fourth, the aboriginal beliefs and myths. At the outset, it had been planned to devote the entire attention of the Bureau's specialists to the living Indians, in order that all possible information might be secured before the tribes vanished or were so changed by contact with the white man that little remained of the native culture. But in

1881 Congress added to the functions of the Bureau the study of the prehistoric remains of the ancient Indians, so that thereafter this became an important branch of the work.

The language publications are often most abstruse, and the expression of the Indian sounds in the English alphabet requires the use of many unusual diacritical marks. It is said that setting the type for some of the larger of these linguistic texts has turned gray the hair of the compositors at the Government Printing Office assigned to them. To show that there may be some truth in this, there is shown on the accompanying plate a reproduction of a page of Indian text from one of the Bureau's publications.

The native Indian arts have been an object of exhaustive study by the staff of the Bureau. Decorative art as exhibited on pottery, textiles, basketry, and artifacts; architecture, from the cliff villages of the Southwest to the earth lodges of the great plains; language expressed in pictographs and hieroglyphics; and music have all yielded rich returns of knowledge and illustrative specimens. The pottery decoration is among the most striking features of the native art, and the nature and relative amount of decoration has proved to be of great value in the cultural classification of the various tribes. Pottery bowls from certain regions contain striking geometric designs so complicated and of such exactness that it seems incredible for the native potters to have produced them with no patterns or drawing instruments. The Bureau's publications describing and illustrating these striking pottery decorations have been in great popular demand, and the figures themselves have frequently been used by ceramists and designers in their work. The distinctive Indian motifs have at times had quite a vogue, as representing true American designs.

The study of native Indian music conducted for many years by Miss Frances Densmore, as collaborator of the

Bureau, has attracted uncommon interest. Miss Densmore goes among the Indians themselves, and after winning their confidence and friendship, persuades them to sing for her their native songs of war, victory, and love, dance songs, and ceremonial songs. These she records by means of a recording phonograph, and at the close of the field season, transports the wax records to Washington and subjects them to a thorough study. The Indians who visit Washington are sometimes persuaded to record songs for Miss Densmore in her office, and at such times the halls of the Smithsonian resound with the guttural monotones and piercing whoops of the ancient war songs. After studying the records, Miss Densmore transcribes the songs and the Bureau publishes her account of them with the transcriptions.

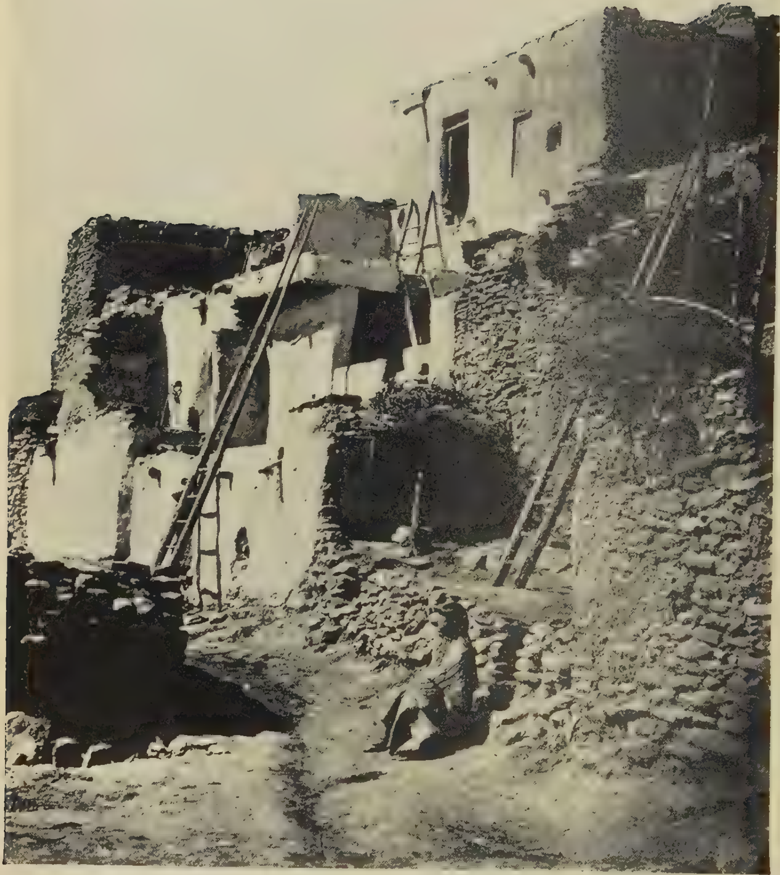
During her years of close contact with several Indian tribes, Miss Densmore has had many interesting experiences. A quiet-mannered woman with an absorbing interest in her work, she has learned the ways of the Indians and how to secure their confidence. During her work among the Sioux some years ago, she was adopted by the chief, Red Fox, to take the place of his daughter whom he had lost. After this event, Miss Densmore experienced little trouble in securing songs from the Sioux, recording as many as 130 songs in one season. Among the Sioux informants was Jaw, an old warrior who had a wide reputation for stealing horses in which he took considerable pride, and he not only recorded songs dealing with his exploits, but had them illustrated by native drawings depicting the events.

Miss Densmore's transcriptions of the native Indian music have been used very successfully by certain American composers, notably Cadman, as the themes for a number of interesting compositions.

Indian houses are of various forms, according to the materials at hand and the habits of the peoples. Among the numerous forms of native domiciles encoun-

PLATE 41

Sword swallowers of Ma'ʻke ʻHlan'nakwe, the Great Fire Fraternity of the Zuñi Indians. From Bureau of American Ethnology study



A primitive Indian apartment house. Street in the Hopi pueblo of Oraibi, Arizona

tered are the snow and ice houses of the Arctic Circle; the rough plank houses with their elaborately carved totem poles found in Alaska; the earth lodges of the northern interior tribes; the great community pueblos of the Southwest, termed "prehistoric apartment houses," one building sometimes accommodating many hundreds of inhabitants, and all with their mysterious kivas, or circular ceremonial rooms; the skin houses of the plains; the bark wigwams of the forests of the East; the grass houses of the Southwest; the cliff houses in the steep-walled canyons of the West; and the adobe villages of the desert country—all of these diversified native dwellings have been described in the Bureau publications.

Beginning with the earliest researches by Major Powell among the Rocky Mountain tribes, it was observed that there existed a definite set of tribal laws, which though of course unwritten, were nevertheless most rigidly adhered to and perpetuated by word-of-mouth descent from generation to generation. Among the most interesting of the tribal laws were those relating to marriage, which prescribed generally, although varying somewhat among the individual tribes, that a man must select a wife from his own tribe, but could not marry within his own clan. This somewhat strict regulation was prevented from becoming too onerous and interfering with tribal harmony by adding certain provisions by means of which it might be circumvented. For instance, a couple prohibited by this regulation from marrying could elope, and if they were clever enough to avoid capture and vengeance for a certain length of time, they were pardoned and again accepted into their own clan. In other cases, the prohibitions were lifted provided the suitor was able through his own valor to capture the lady of his choice. With certain tribes, when two suitors appeared for the favor of the same woman, provision was made for settling the matter through mortal combat.

Among the most interesting and difficult phases of the

study of the Indians is that of their rites and ceremonies. The native faith is so involved in mysticism and belief in the supernatural that it is difficult for the civilized mind to comprehend their method of reasoning. This faith is expressed and symbolized in innumerable rites and ceremonies, some simple and confined to the individual and others most elaborate, lasting several days and nights and taken part in by nearly the whole tribe. These beliefs and ceremonies have been studied and analyzed, and many of the Bureau's publications relate to this phase of ethnology. The ceremonies themselves can only be studied by going among the Indians and making first-hand observations. The following is a typical preliminary account of the results of such field studies. It relates to the Osage Indians of Oklahoma, who have been studied by Dr. Francis La Flesche, of the Bureau staff, for a number of years. In 1913 Doctor La Flesche succeeded in securing the songs and rituals of five of the Osage ceremonies, regarding which he writes:

"Two of these are practically complete; the others are fragmentary, but enough information was obtained to give a fair idea as to their significance. These rites are: Wa-do′-ka We-ko, Scalp Ceremony; Wa-zhi*n*′-gao, Bird Ceremony for boys; Wa-wa-tho*n*, Peace Ceremony; Zhi*n*-ga′-zhi*n*-ga Zha-zhe Tha-dse, Naming of a Child; and We-xthe-xthe, Tattooing Ceremony.

"Owing to the superstitious hold these rites have upon the people, together with the fact that every initiated person obtained his knowledge at a great expense, it was almost impossible to procure complete texts of any of the ceremonies.

"The Tattooing Ceremony is of peculiar interest. It was more difficult to secure information concerning it than of any other ceremony. In earlier times only the warrior who had won war honors was entitled to have the ceremony performed and to have the war symbols tattooed upon his body. If his means permitted it, they might also

be placed upon any number of his relatives. These war symbols were his marks of distinction as a man of valor, for the strength and life of the tribe depended upon the prowess of the warriors. In those days there were but few who were entitled to have the ceremony performed, because war honors were not easily won and few were wealthy enough to afford the expense of the ceremonies. When, during the last century, wars between the various tribes ceased, the real significance of the rite vanished, but the superstitious belief that the symbolic figures meant long life to the individual so tattooed remained prominently in the minds of the people.

"About the time that the right of the honored warrior to the exclusive use of the Tattooing Ceremonies came to an end, a new condition arose which materially changed the character of the rite. From the sales of lands to the United States the Osage tribe acquired a wealth by which a greater number of its members were enabled to have performed the tattooing, as well as other ceremonies. It was then that this ancient rite became the means by which any individual could publicly display his affection towards a relative.

"The designs tattooed upon the body of a man were relatively simple. Those on a woman were more elaborate and covered the upper part of her body, breast and back, and the lower part of her legs. The implements used in tattooing were made of wood, about the length of a pencil. To the lower end were attached needles arranged in a straight row, and to the upper end were fastened four small rattles made of the large wing quills of the pelican. This bird is referred to in one of the dream rituals as Mo*n*-thi*n*-the-do*n*-ts'a-ge, He-who-becomes-very-old-while-yet-going. In certain passages of the ritual it is intimated that these implements were originally made of the wing bone of this bird and were used for doctoring as well as for tattooing.

"The coloring matter employed in tattooing is made of

charcoal mixed with kettle black and water. The charcoal is made from certain trees that serve as symbols of long life in the war ceremonies. Tail feathers of the piliated woodpecker are used for putting on the ink and drawing the lines."

Mrs. M. C. Stevenson conducted for many years an intensive study of the primitive beliefs and strange ceremonies, including human sacrifice, of the Tewa Indians of the Rio Grande valley. She has written interesting accounts of this investigation, extracts from one of which follow:

"A close relationship was found to exist among all the Pueblo Indians, especially in their essential beliefs, resulting in a great brotherhood between them. Living in an arid land, the cry of their souls was and is—'rains to water the earth.'

"Primitive man sought to define the mysteries of Nature, to account for its phenomena; thus primitive philosophy was born, and then religion and ritualism crept in. The Pueblo Indian began at an early period to create a pantheon of gods of his worship, gods to be appealed to for the good things of life, and angry gods to be propitiated; and thus, long ago, a most complicated system of religion and rituals developed among such peoples of the Southwest as had homes constructed of stone, clay, and plaster. . . .

"Priesthoods and fraternities were organized, and chambers were built in which to invoke and propitiate the gods. These chambers were circular and built under ground, symbolizing the innermost world whence the people came. As the people ascended from these chambers, they symbolized their emergence from the innermost world into this world; and, although most of the kivas, or Hopi ceremonial chambers, at the present time, are above ground or partially so, they still represent the undermost world, the coming out still symbolizing the emergence from the undermost world, and the kiva the undermost

California Indian baskets in the National Museum

Upper, Yuki sun basket of the type in which the sun was stolen from another world and brought to this.

Lower, Pomo coiled willow basket, beaded, unexcelled in perfection of form

world itself. The kiva is a prominent feature of the archeological remains of the Southwest; there is seldom a mesa, cliff, or cavate ruin where these ceremonial chambers are not to be found. They are the substantial evidence of the worship of the cliff dwellers. . . .

"The Tewa are divided into the Sun and the Ice peoples, therefore there are two kivas, one for each people. Every male child must be initiated into one of the kivas in order to be eligible to dance with the gods after death in the undermost world. The female child is passed through impressive ceremonies by a priest of the kiva, just after birth, and is carried into the presence of the rising sun on the twelfth day. As the tiny infant is held up facing the sun the following prayer is offered to the Sun father: 'May the child grow to womanhood; may she speak with one tongue, be gentle and kind to all, and may all be gentle and kind to her. May her life be so full of love for all the world, and may her acts be so pure that she may be blessed with the love of the Sun father, so that her span of life may be complete, that she may not die, but live long, and become a child again, and so sleep, not die, to awake in the world with the gods. May she ever inhale more of the sacred breath of life.'

"In order that the rain priest may come into closer communion with the gods he must mortify the flesh. Semiannually, at the winter and summer solstice, the rain priests of the Sun and Ice people retire, each with his associates, into the kivas for a retreat of four days and nights, to pray for rains, observing strict fasts, taking only meal-bread, and drinking popcorn water. Here it is that the rain gods are specially invoked. . . .

"Whence come the rains so devoutly prayed for? By direction of the Council of the Gods, the shadow people fill their vases and long-necked gourd jugs from the waters of the six regions, and ascending to the upper plane, provided there are sufficient clouds to protect the rain makers from view of the people of this world, they proceed to

water such portions of the earth as have been assigned to them by the Council. The Tewa priests have given such close observation to the winds and clouds that they are quite weatherwise, and seldom select a time for a rain dance when rains do not follow.

"Zooic worship has to do with the healing of the sick, the beast gods acting as mediators between man and the anthropic gods. The most shocking ceremony associated with the zooic worship of the Tewa is the propitiation of the rattlesnake with human sacrifice to prevent further destruction from the venomous bites of the reptile. The greatest secrecy is observed and the ceremonies are performed without the knowledge of the people except those directly associated with the rite which is performed quadrennially. Although many legends of the various Pueblos have pointed indirectly to human sacrifice in the past, it was a revelation to [learn] that this rite was observed by the Tewa at the present time [1912]; and, while it is said to exist in only two of the villages, [it is believed] that they are not exceptions. In one village the subject is said to be the youngest female infant; in the other village an adult woman is reported to be sacrificed, a woman without husband or children being selected whenever possible. The sacrificial ceremonies occur in the kiva. The subjects are drugged with *Datura meteloides* until life is supposed to be extinct. At the proper time the body is placed upon a sand painting on the floor before the table altar and the ceremony proceeds amid incantations and strange performances. The infant is nude, and the woman is but scantily clad. After the flesh has decomposed and nothing but the bones remain the skeleton is deposited, with offerings, beneath the floor of an adjoining room of the kiva. The entire ceremony is performed with the greatest solemnity."

These two instances will serve to illustrate the interest which lies in these primitive rites and beliefs, and a great many of the publications of the Bureau

of Ethnology have been devoted to their recital and explanation.

Major Powell, the founder of the Bureau, under whose able direction these systematic studies of the Indians were conducted, died on September 23, 1902, and in the following month Dr. W. H. Holmes was appointed to succeed him as Chief of the Bureau. Doctor Holmes advanced the work vigorously until 1910, when he was called to the position of head curator of the department of anthropology in the National Museum and Curator of the National Gallery of Art (now the National Collection of Fine Arts). He in turn was succeeded by Mr. F. W. Hodge, who assumed the title "Ethnologist-in-Charge." Mr. Hodge, in addition to ably administering the affairs of the Bureau and conducting a number of important archeological researches, edited the now famous "Handbook of American Indians North of Mexico," the two parts of which total over 2,000 pages. The great popularity and usefulness of this exhaustive work caused it to go out of print in a very few years, and a reprint authorized by concurrent resolution of Congress soon suffered the same fate. In 1918 Mr. Hodge accepted a position with the Museum of the American Indian (Heye Foundation) in New York, and Dr. J. Walter Fewkes was appointed Chief of the Bureau to succeed him.

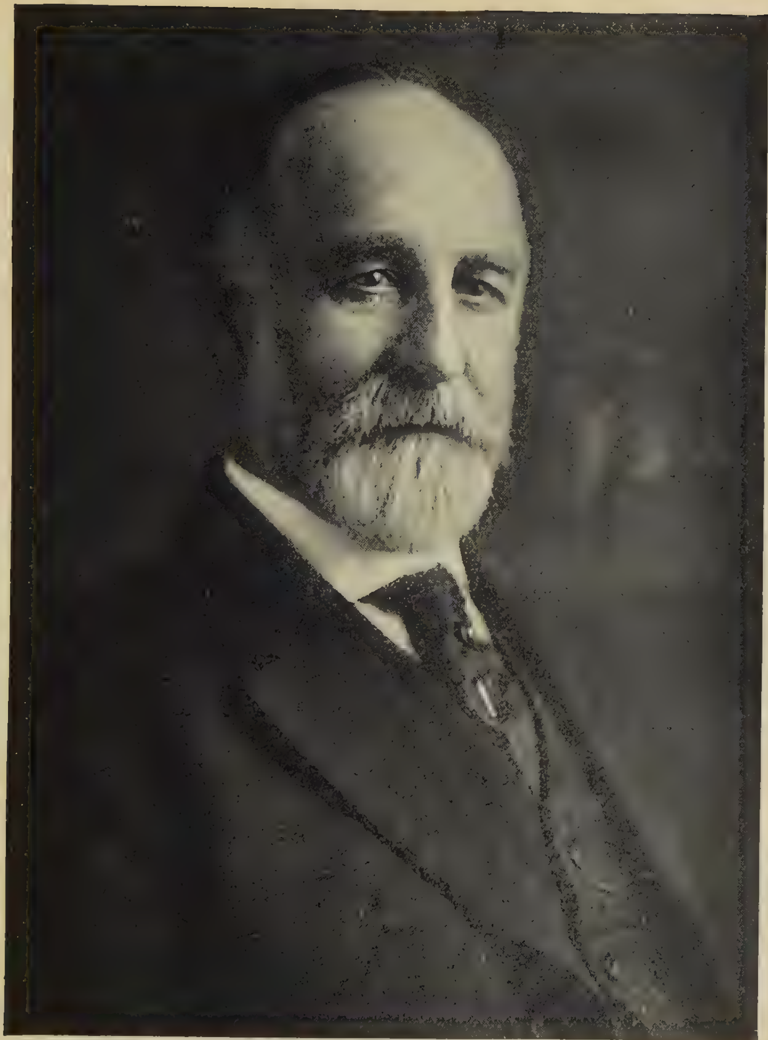
Doctor Fewkes was a man of broad culture and wide experience in various fields of anthropological research. A man of kindly humor and generous appreciation of the work of others, perhaps his most noticeable characteristic, next to his enthusiasm and ability in scientific work, was his geniality. For a number of field seasons Doctor Fewkes engaged in uncovering and repairing prehistoric ruins in various parts of the United States, notably the Mesa Verde National Park in Colorado, and many hundreds of tourists met him and heard the informal talks on the ruins which he often gave in the field. During the winter, there was a steady stream of visitors to Dr. Fewkes's office, including

many of those who had met him during the previous season and only wished to shake hands again with "the Doctor."

Doctor Fewkes was one of the first ethnologists to study the Hopi Indians of Arizona. He lived among them in their pueblos for several seasons, and has published many papers on their customs and beliefs. The confidence shown in him by the Hopi Indians is attested by the fact that one season they actually made him one of their priests. Doctor Fewkes had many amusing incidents to relate regarding this period spent among the Indians, as when, in preparing for one of their numerous ceremonies, the priests came to him and asked him to remove his effects from the sleeping place which he had occupied for some months. Somewhat puzzled by this request, he did what they asked, and the priests calmly removed the top from his "built-in bed" and took from within a number of live rattlesnakes which they had been keeping there for the ceremony.

In later years, Doctor Fewkes's attention was largely turned to archeology, and he brought to light and preserved for the instruction of visitors many novel and important prehistoric Indian dwellings. Among these should be mentioned the famous Cliff Palace, Spruce-Tree House, Square-Tower House, Pipe-Shrine House, Sun Temple, and many others. Regarding the discovery of the remarkable structure known as Sun Temple, Doctor Fewkes said:

"The field work last summer [1915] was devoted to a large building situated on the point opposite Cliff Palace. This work was unusually successful in that it revealed a new type of prehistoric building 121.7 feet long by 340 feet around the north or semicircular side. This ruin, to which the name Sun Temple has been given, is considered one of the most mysterious structures in the Southwest. It was completely excavated, the fallen earth and stones were removed, and the walls thoroughly repaired, the most improved methods being adopted for their preserva-



Jesse Walter Fewkes, former Chief of the Bureau of American Ethnology of the Smithsonian Institution

Cliff Palace, Mesa Verde National Park, Colorado, excavated and repaired for preservation by Dr. J. Walter Fewkes, former Chief of the Bureau of American Ethnology

tion from the elements. The ground plan shows an original building and an annex, shaped like a capital letter D. Adjoining the southwest corner of the annex, on the outside, were built two walls forming an enclosure identified as a shrine, the floor of which is formed by the upper face of the southwest cornerstone of the building. In this floor is a fossil palm, suggesting a symbol of the sun, which has given the name to the ruin. The mound covering the ruined walls of Sun Temple dates back to 1555, as indicated by a cedar tree having 360 annual 'rings' which was found growing on the top of the highest wall. There is no way of telling how much earlier the mound was formed or how many years before it became a mound the foundations of the building were laid. It is, however, believed that worship at the sun shrine undoubtedly antedated the construction of the building.

"The Sun Temple was probably built by the neighboring cliff dwellers and is regarded as more modern than Cliff Palace. The unity of plan shown in Sun Temple indicated union of several clans in its construction and the existence of a higher social organization than at Cliff Palace. It was constructed for a ceremonial building with a secondary purpose of storage and refuge in time of trouble, but shows evidence that it was never finished."

Early in 1928 Doctor Fewkes retired as Chief of the Bureau at the age of seventy-seven years, and Mr. Matthew W. Stirling was appointed to succeed him.

The work of the Bureau of American Ethnology is unique in that it is of great scientific value and at the same time of popular interest. In certain phases of the work there is urgent need of haste, as the rapid absorption of the native Indian culture into modern life is rendering information regarding it more and more difficult to obtain. It would be a serious loss to posterity if this material were allowed to pass into oblivion, and the Bureau is making every effort to rescue and record it. Particularly is this true of the Indian languages. Several of them

are now spoken only by a few survivors, old men and women, and when they pass on, the knowledge which they possess will disappear forever. The pure-bred Indian as a race is rapidly passing, and it is the duty of the Bureau to record as much as possible of the history of this interesting people.

> "Of the grandeur of our temple-walls
> But mounds of earth remain,
> And over our altars and our graves
> Your towers rise proud and high"
>
> —Edna Dean Proctor.

CHAPTER VIII

THE NATIONAL COLLECTION OF FINE ARTS

ART is inborn with humanity. Whether in the crude drawings of animals in the paleolithic caverns of France, in the masterly sculptures of ancient Greece, or in the loveliest paintings of modern Europe—everywhere we see the striving of man for expression through the medium of art. Every civilized nation on the face of the earth maintains its art galleries and fosters the study of art in various ways.

As long ago as 1846, in the Act establishing the Smithsonian Institution, Congress provided for the formation of a museum, a gallery of art, and a library. The same Act provided that there should be transferred to the Smithsonian "all objects of art, of foreign and curious research and of natural history, belonging to the United States." The very first collection purchased from the Smithson fund, even before the Smithsonian building was completed, was a large series of engravings and etchings, at that time undoubtedly the finest collection of the kind in America.

Although the art feature was by no means lost sight of, it lay practically dormant for a number of years. In 1865 the Smithsonian contained only the collections inherited from the National Institute, a number of miscellaneous paintings and sculptures, and some three hundred Indian portraits and scenes, chiefly by Stanley and King. This art nucleus was scattered over the Smithsonian building and could hardly be entitled to the designation "art gallery."

Slow as had been the progress of the art phase of the Smithsonian up to this time, an event occurred in 1865 which retarded it still further and proved so discouraging that the embryo National Gallery remained practically at a standstill for thirty years. The Smithsonian building was visited on January 24, 1865, by a disastrous fire which gutted the entire second story of the central part of the building, as well as the large towers at the front and back of this section. The fire occurred in the following manner: In the large gallery in the center of the second story of the building were hung the Stanley and King Indian paintings just mentioned. It had been decided to exhibit in connection with these a collection of ethnological material pertaining to the Indians portrayed, and a series of large cases had just been constructed to receive it. In order to show this material to best advantage it was necessary to rearrange the paintings. The day was extremely cold and the gallery was large and poorly heated, so that the workmen found it necessary to bring in a stove temporarily. They located a flue-opening, connected the stovepipe in it, and built a roaring fire. Unfortunately the flue which they had selected, instead of being a chimney flue, proved to be for ventilation purposes, and opened just *under* the roof. The consequences can readily be imagined, and the fire spread so rapidly that it soon became practically beyond control. Fortunately the floor between stories proved to be really fireproof, so that the first story and the two wings were saved.

Practically all of the art collection was wiped out, and no funds being available to rehabilitate it, art as a national enterprise continued in a state of arrested development for many years. A number of small art collections were received, some of them of considerable importance, such as the Grant collection, the Watts de Peyster collection, and the Catlin Indian paintings, thus at least keeping alive the art feature of the Institution. It was in 1903, however, that it received its first great stimulus.

PLATE 46

Burning of the Smithsonian Institution, January 24, 1865. From a contemporary sketch in *Harper's Weekly*

PLATE 47

One of the five Stanley Indian paintings saved from the Smithsonian fire

In July of that year occurred the death of Mrs. Harriet Lane Johnston, niece of President Buchanan, and mistress of the White House during his incumbency. It was found that she had bequeathed her private art collection, including a number of paintings by great masters, under certain conditions to the Corcoran Art Gallery of Washington, with the provision that should the Government establish an art gallery, the collection should thereupon be delivered to such National Art Gallery. Under the conditions specified in Mrs. Johnston's will, the Corcoran Gallery found it inexpedient to accept the collection. The executors of the estate felt that, although the Smithsonian Institution had been designated by Congress as the legal repository of all art objects belonging to the United States, nevertheless the title "National Art Gallery," as specified in the will, had never been formally adopted, and they were accordingly without authority to turn over the Harriet Lane Johnston collection to the Institution. Therefore they filed a suit in the Supreme Court of the District of Columbia, asking for a decision on such portions of the will as were subject to doubt. The Attorney General entered the suit on behalf of the United States, as having an interest in the matter. The decision finally rendered by the court was as follows:

"It is, therefore, on this eleventh day of July, in the year 1906, by the Supreme Court of the District of Columbia, sitting in Equity, and by the authority thereof, adjudged, ordered, and decreed;

"That there has been established by the United States of America in the City of Washington a National Art Gallery, within the scope and meaning of that part of the codicil bearing date April 21, 1902, made by the said Harriet Lane Johnston to the Last Will and Testament, in the proceedings in this case mentioned, wherein she gave and bequeathed the pictures, miniatures, and other articles, to the Trustees of the Corcoran Gallery of Art, and in the event of the Government establishing in the

City of Washington a National Art Gallery, then that the said pictures and other articles above mentioned should be delivered to the said National Art Gallery and become its property; and that the said National Art Gallery is the National Art Gallery established by the United States of America at, and in connection with, the Smithsonian Institution located in the District of Columbia and described in the Act of Congress entitled an Act to establish the 'Smithsonian Institution' for the Increase and Diffusion of Knowledge among men . . . and the subsequent Acts of Congress amendatory thereof; and it is further adjudged, ordered and decreed, that the United States of America is entitled to demand and receive from the surviving Executors of the said Harriet Lane Johnston, the Complainants named in the Bill of Complaint in this case, all of the above mentioned pictures, articles of sculpture, engravings, miniatures and other articles, the same to be and become a part of the said National Art Gallery so established by the United States of America at, and in connection with, the said Smithsonian Institution.

(Signed) "WENDELL P. STAFFORD, *Justice.*"

This court decree was the most important event in the history of the gallery. It had the threefold effect of establishing definitely its status as the National Gallery of Art of the United States, of securing for it a valuable art collection, and of drawing the attention of the public generally to the fact that America possessed a National Gallery of Art which had just received an important nucleus in the Harriet Lane Johnston collection. From this time forward, the collections and standing of the National Gallery advanced by leaps and bounds, and it was not long until the problem of how to obtain additional material was transformed into embarrassment to find exhibition space for the rapidly growing collections.

His attention called to the Smithsonian by the Johnston

"Ruins and Figures," by Francesco Guardi, 1712–1793. In the Ralph Cross Johnson collection, National Gallery of Art

bequest, Mr. Charles L. Freer, of Detroit, offered the Institution his unique collection of over 2,000 pieces representative of the best American and Oriental art. This magnificent gift by Mr. Freer to the Nation will be described fully in the next chapter, so that no further mention of it will be made here. A few months later another notable collection consisting of fifty paintings by contemporary American artists came to the National Gallery as a gift from Mr. William T. Evans, of New York. This gift, which has since been increased by Mr. Evans to include 150 pieces, is regarded as one of the choicest collections of the work of contemporary American artists in existence.

These accessions and others of less importance made it imperative to provide at least a temporary organization and location for the National Gallery. As a tentative arrangement, the lecture hall of the older National Museum building was fitted up as an art gallery and Dr. William H. Holmes, at that time Chief of the Bureau of American Ethnology, and an artist of recognized standing, was given the additional designation of Curator of the National Gallery of Art, but without compensation, as there were no funds available for providing a gallery staff. With the additions to the collections which continued to come in, the space allotted soon became entirely inadequate, and with the completion in 1909 of the beautiful Natural History Building of the National Museum provided by Congress, the central sky-lighted hall on the first floor was assigned to the National Gallery and subdivided into suitably sized rooms. This improvised gallery, though fairly satisfactory for exhibition purposes, was still far too small, and much valuable material was consequently forced into storage.

A thoughtful provision was made in 1916 by a private citizen, Mr. Henry Ward Ranger, for the continuous increase of the National Gallery collections. In his will he bequeathed a fund of $200,000, to be administered by

the National Academy of Design, from the income of which there were to be purchased works of art under the following provisions:

"All pictures so purchased are to be given by the council [of the Academy] to art institutions in America, or to any library or other institution in America maintaining a gallery open to the public, all such gifts to be upon the express condition that the National Gallery at Washington, administered by the Smithsonian Institute, shall have the option and right, without cost, to take, reclaim, and own any picture for their collection, provided they exercise such option and right at any time during the five-year period beginning ten years after the artist's death and ending fifteen years after his death, and, if such option and right is not exercised during such period the picture shall remain and be the property of the institution to which it was first given."

A few important paintings have already been added to the National Gallery from the Ranger Fund, and more than sixty have up to the present time been purchased and assigned to various institutions under the provisions cited above.

In 1919 a notable addition was made to the National Gallery by Mr. Ralph Cross Johnson, of Washington, who presented a rare and valuable collection of twenty-four paintings representing the finest work of nineteen European old masters. Regarding this gift, Mr. George B. Rose writes:

"It is easy for a man to leave his pictures to a public gallery after his death. He knows that he is thus erecting to his memory one of the noblest and most enduring of monuments, and that he is insuring the beloved objects against destruction. But for the living art lover to part with his treasures is hard indeed. A thing of beauty is a joy forever, and the longer we own it the closer it twines itself about our hearts. We all remember the story of Cardinal Mazarin taking leave of his pictures. He was a pas-

sionate and discriminating lover of art, and his great collection is still the chief glory of the Louvre. When told that he must die, he had himself borne to his gallery, and there he took a last, long, fond, lingering view of each cherished possession, parting from them all with an agonizing regret. He could surrender earthly power and splendor with no great repining; but to part with the pictures that he loved so much tore his heart.

"And so it is with every true lover of art. He is willing to lend his pictures to the public, that others may share his joy for a time. Occasionally out of a large number he will give one to some public gallery. But rarely indeed does he do more until forced by the hand of death to yield them up. The gift by Mr. Ralph Cross Johnson of twenty-four choice old masters, to our National Gallery, has been seldom paralleled."

Influenced in part by this striking gift and in part by the increasing general interest in the National Gallery as the Nation's contribution to art development in America, Congress in 1920, through a small appropriation in the Sundry Civil Act, provided "for the administration of the National Gallery of Art by the Smithsonian Institution, including compensation of necessary employees and necessary incidental expenses." This important action resulted on July 1, 1920, in elevating the National Gallery, until that time administered as a part of the National Museum, to the rank of a distinct administrative branch under the immediate direction of the Smithsonian Institution. Dr. William H. Holmes, for a number of years head curator of the department of anthropology in the National Museum and at the same time acting as Curator of the Gallery, was appointed Director, a small staff was provided, and the National Gallery of Art was thus launched as a distinct enterprise.

Since the great stimulus given to the Gallery in 1903 by the Harriet Lane Johnston bequest, additions to the collections had come in steadily, until by 1920 the Gallery

had attained a recognized standing among art institutions and the value of the collections ran into several million dollars. After this year, however, there became apparent a marked decrease in the number and value of the yearly additions, and the reason was not far to seek. All of the available space was fully occupied and much valuable material was stored away out of sight. It will readily be understood that prospective donors, who might otherwise have preferred to see their art works exhibited in the Nation's art gallery, would not be willing to bring them where obviously there was no suitable space for their display. This situation led to the definite realization that there must be provided in the near future an adequate building for the National Gallery of Art to insure its normal and beneficial expansion. Doctor Holmes, Director of the Gallery, has eloquently summed up the situation in these words:

"The story of the National Gallery of Art from its beginning nearly a century ago is the record of the prolonged struggle of the art idea for national recognition, for a place in the serious consideration of the American people; and it is to be regretted that today, although art institutions are springing up on all hands, art has had slight national recognition beyond the attention necessary to the care and display of the art treasures acquired by gift and bequest. For nearly a century the Smithsonian Institution has harbored the dream of a gallery of art, but art has been in the shadow of diversified scientific activities and in the deeper shadow of the all-absorbing material interests of a rapidly developing Nation. Today the conditions are far from satisfactory. Growth of the collections through gratuitous contributions, even, is embarrassed by the almost complete exhaustion of space for the reception and display of all save accessions of very limited extent, and the problem before the Institution, and certainly with equal insistence before the American people, is 'Shall America have a National Gallery of Art,

or a National Museum of Art, that will give us a respectable place among the cultured nations of the world?' The story of the vicissitudes of the incipient, struggling national gallery makes known a national shortcoming, and should deeply stir the pride of a people not accustomed to take a second or a third place in any field worthy of their ambition."

In another place Dr. Holmes records his understanding of the purpose of a national gallery as follows:

"It should not be forgotten that in erecting a building for art, we are rearing a temple to be devoted, not to painting and sculpture alone, but to the assemblage and display of the richest achievements of human genius in every branch in which the esthetic in material form is realized: in sculpture, painting, architecture, metallurgy, ceramic art, textiles, and the rest, in all of their diversified forms of realization.

"These treasures would serve, not only as records of past achievements—as monuments to human genius, but as the foundation upon which America's art future would be built, insuring its advance, step by step, to higher levels than the world of the present can claim, or the past has known."

In the year 1923 Congress set aside a site in the Smithsonian grounds, between the present Natural History Building of the National Museum, and Seventh Street, for a National Gallery building, but provided no funds for its erection. It did, however, authorize the Board of Regents of the Institution to have prepared preliminary plans for a building, and under this authorization the Regents privately raised a fund of ten thousand dollars for the purpose. The architect selected was Mr. Charles A. Platt, of New York, who was also the architect of the Freer Gallery building. Mr. Platt, after examining personally all of the famous European galleries of art, drew his preliminary plans for a building fitted in every way to be the home of the Nation's art treasures.

In 1924, Senator Henry Cabot Lodge offered as an amendment to the Second Deficiency Bill the following:

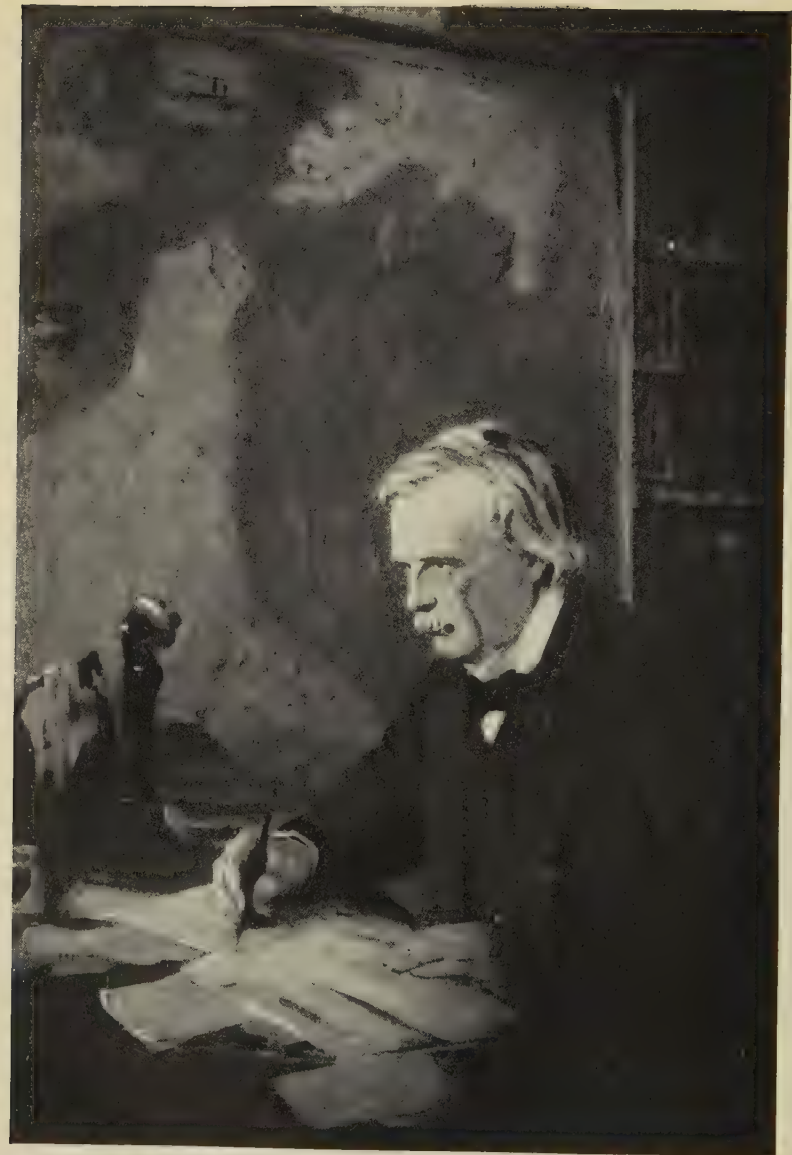
"To enable the Regents of the Smithsonian Institution to commence the erection of a suitable fireproof building with granite fronts for the National Gallery of Art, including the National Portrait Gallery and the history collections of the United States National Museum, on the north side of the Mall between the Natural History Building and Seventh Street, $2,500,000; Provided, that the total cost of said building complete, including heating and ventilating apparatus and elevators, shall not exceed $7,000,000."

Unfortunately the amendment was not accepted, and the National Gallery of Art remained without a suitable building.

Immediately after the close of World War I, the realization came to a number of prominent art patrons in this country that the portraits of the great leaders, both civil and military, of America and the allied nations should be secured at once and assembled in Washington, as a permanent pictorial record of the leading figures of that stirring period. With this thought in mind, there was organized the National Art Committee, with the endorsement of the Smithsonian Institution, the American Federation of Arts, and the American Mission to Negotiate Peace, composed of the following: Hon. Henry White, Chairman; Herbert L. Pratt, Secretary and Treasurer; W. H. Croker, Robert W. de Forest, Abram Garfield, Mrs. E. H. Harriman, Arthur W. Meeker, J. Pierpont Morgan, Charles P. Taft, Henry C. Frick, and Charles D. Walcott.

This Committee took immediate steps to obtain the consent of the subjects for the painting of their portraits, and made arrangements with eight of the leading American portrait painters. In order to make the plan national in character, it was arranged that a group of these portraits financed by the art patrons of any American city would

"Illusions," by Henry Brown Fuller. Evans collection, National Collection of Fine Arts



Portrait of Lloyd George, by Douglas Volk, N. A. In the portrait collection of World War leaders, National Collection of Fine Arts

be inscribed as presented to the National Portrait Gallery by that city. Thirteen of the completed portraits have thus been presented in groups by the cities of Chicago, Cincinnati, Cleveland, New York, and San Francisco. Eight portraits have not yet been arranged for by any city.

This collection of portraits of the outstanding figures in the dramatic days of World War I will, as time goes on, be of greater and greater interest to all patriotic Americans. The subjects and the artists who have portrayed them are as follows:

By John C. Johansen
- Field Marshal Haig
- Marshal Joffre
- General Diaz
- "Signing of the Peace Treaty, 1919"
- Premier Orlando

By Douglas Volk
- Albert, King of the Belgians
- Premier Lloyd George
- General Pershing

By Charles Hopkinson
- Premier Bratiano
- Premier Pashich
- Prince Saionji

By Edmund C. Tarbell
- President Wilson
- General Leman
- Marshal Foch
- Herbert Hoover

By Cecilia Beaux
- Cardinal Mercier
- Admiral Beatty
- Premier Clemenceau

By Joseph De Camp
- Premier Borden
- General Currie

By Irvin R. Wiles
- Admiral Sims

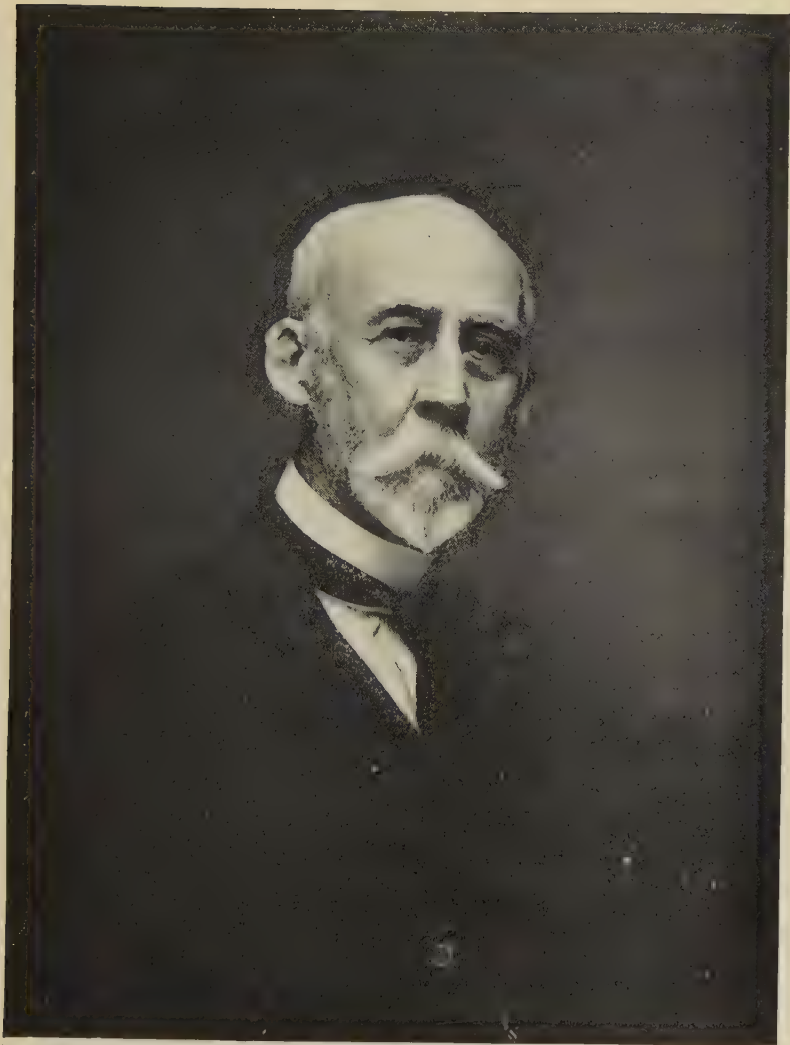
By Jean McLane (Mrs. John C. Johansen)
- Elizabeth, Queen of the Belgians

Shortly after the creation of the National Gallery as a separate unit under the Smithsonian, the Board of Regents, with the future of the Gallery in mind, organized the National Gallery of Art Commission, "to promote the administration, development, and utilization of the National Gallery of Art, including the acquisition of material of high quality representing the fine arts; and the study of the best methods of exhibiting material to the public and its utilization for instruction." At the first meeting of the Commission in June, 1921, the organization was

perfected, and committees were appointed to take charge of the various branches of the work. An indication of the breadth of scope planned for the Gallery in the future is given in the subjects covered by the committees formed: American painting, modern European painting, ancient European painting, Oriental art, sculpture, architecture, mural painting, ceramics, textiles, prints, and portrait gallery.

When Mr. Mellon in 1937 gave to the nation his magnificent collection and a splendid building to house it, this was awarded the name "National Gallery of Art." The collection at the Smithsonian formerly so called was thereafter designated "The National Collection of Fine Arts."

It would be impossible to close this account of the National Collection of Fine Arts without a brief mention of the most striking figure of its history—the former Director, Dr. William H. Holmes. Tall, slender, distinguished-looking, with white hair and beard, he was a man remarkable for the diversity of his attainments. Born in 1846, the year of the establishment of the Smithsonian Institution, he played for many years a prominent part in its activities. His first work was with the U. S. Geological Survey, where he made an enviable record as a geologist. He next turned to anthropology and archeology and working with various institutions, including the National Museum and the Bureau of American Ethnology of the Smithsonian, his contributions to these sciences are known throughout the world. Not content with mastery in two major branches of science, in which his eminence is attested by membership in the National Academy of Sciences, he had from his early years pursued the study of art, and in this also his reputation became nation-wide. From Chief of the Bureau of American Ethnology, he was transferred to the position of head curator of the department of anthropology in the National Museum, and at this time he was also designated Curator of the growing



William Henry Holmes, former Director of the National Gallery of Art, now the National Collection of Fine Arts, artist, geologist, and anthropologist

National Gallery. With its establishment as a separate administrative branch under the Institution, his was the only name considered for its first Directorship.

Doctor Holmes was possessed of a deep, rich voice and a very impressive manner, and in looking at his likeness reproduced here, we can almost hear him say:

"The rank of a people in the scale of culture may, in large measure, be determined by the degree of its appreciation of beauty and by its embodiment of the elements of beauty in the works of its hands; while the art museum, the treasure house of that which is beautiful, has the important function of placing before the people for their contemplation and instruction, examples of the products of taste in every branch from the simplest forms of embellishment to the loftiest achievements of the masters."

CHAPTER IX

THE SMITHSONIAN'S GREATEST PRIVATE TRUST—THE FREER GALLERY OF ART

On May 5, 1906, Charles Lang Freer of Detroit executed a formal deed of gift to the Smithsonian Institution, placing under its charge for the American people his unrivaled collections of American and Oriental art. This gift was later increased by the provision for a beautiful building to contain the collection and funds to care for it; and still later was crowned by a very large bequest, the income to be used solely to promote the study of the civilization of the Far East and the appreciation of high ideals of beauty. Mr. Freer's foundations have now a money value of quite ten millions, and stand among the world's largest individual benefactions in the field of art and culture.

As early as 1904, Mr. Freer, no doubt influenced by the bequest in 1903 by Harriet Lane Johnston of her private art collection to the "National Art Gallery," transmitted to the Smithsonian an offer to bequeath his entire art collection to the United States, through the Institution, and to provide in his will for the erection of a suitable building to house the collection. In this offer he described his purpose in assembling the extensive collection as follows:

"These several collections include specimens of very widely separated periods of artistic development, beginning before the birth of Christ and ending today. No attempt has been made to secure specimens from unsympathetic sources, my collecting having been confined to American and Asiatic Schools. My great desire has been

to unite modern work with masterpieces of certain periods of high civilization harmonious in spiritual and physical suggestion, having the power to broaden esthetic culture and the grace to elevate the human mind.

"These collections I desire to retain during my life for the enjoyment of students, my friends and myself, and for the further purpose of making additions and improvements from time to time. Believing that good models only should be used in artistic instruction, I wish to continue my censorship, aided by the best expert advice, and remove every undesirable article, and add in the future whatever I can obtain of like harmonious standard quality."

Mr. Freer's remarkable offer was placed before the next annual meeting of the Smithsonian Regents in January, 1905, and was most carefully considered. The only consideration which occasioned the slightest hesitation was the fact that the space allotted to the National Gallery was then entirely inadequate and already overcrowded, and there was some doubt as to what arrangements could be made for the objects after Mr. Freer's death and before the completion of the building which he offered to provide. A committee of the Regents brought the matter to the attention of President Theodore Roosevelt and asked his advice regarding Mr. Freer's offer. With Mr. Roosevelt there was no hesitation. With his characteristic vigor and enthusiasm, he brought his fist down on the arm of his chair and said, "Gentlemen, accept this collection whether you can care for it or not!"

The Regents, acting on this bold advice, accepted the collection on the proffered terms. The final wording of Mr. Freer's offer, addressed to President Roosevelt, was in part as follows:

"To the President:

"Permit me to repeat my offer to bequeath my art collections to the Smithsonian Institution or to the United States Government, and also the sum of $500,000 in

money for the purpose of constructing a suitable building in which to house them, upon the following terms and conditions:

"*First.* The sum of $500,000 shall by paid by my executors to the Regents of the Smithsonian Institution or the United States Government promptly after my decease, and shall be used forthwith for the construction of a fireproof building connected with the National Museum, the construction of which has been recently authorized, or reasonably near thereto.

"*Second.* The interior of this building shall be arranged with special regard for the convenience of students and others desirous of an opportunity for uninterrupted study. A suitable space shall be provided in which the Peacock Room should be re-erected complete. The whole interior arrangement of the building shall be agreed upon between the Regents of the Smithsonian Institution and myself within a reasonable time after the acceptance of this offer.

"*Third.* The collections, with such additions thereto as shall be made during my lifetime, shall be delivered by my executors to the Regents immediately after the building is constructed and ready to receive them.

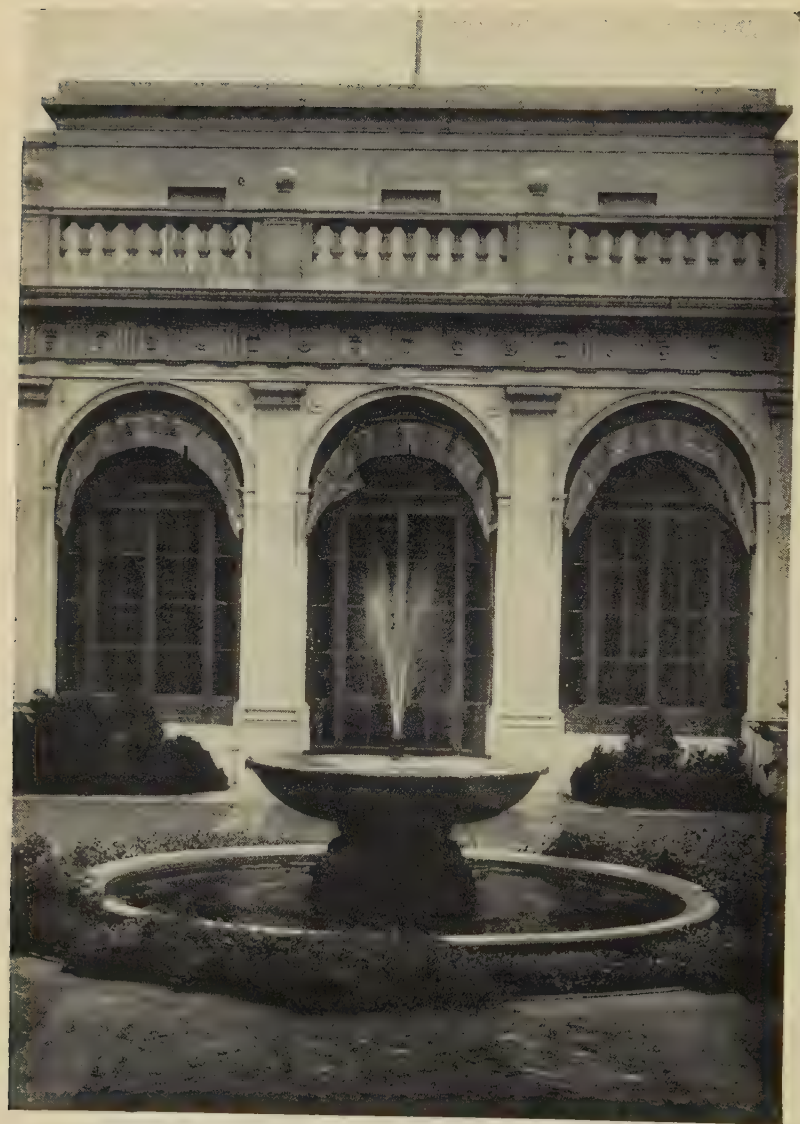
"*Fourth.* The collections and the building shall be cared for and maintained perpetually by the Smithsonian Institution or the United States Government at its own expense.

"*Fifth.* No addition or deduction shall be made to the collections after my death, and nothing else shall ever be exhibited with them, or in the same building, nor shall the said collections, or any part thereof, be removed at any time from the said building except when necessary for the purpose of making repairs or renovations in the building.

"*Sixth.* No charge shall ever be made for admission to the building or for the privilege of examining or studying the collections.

PLATE 54

John Ellerton Lodge, former Director of the Freer Gallery of Art



Open court with fountain in the Freer Gallery of Art

"*Seventh.* The collections and building shall always bear my name in some modest and appropriate form."

(The letter then states that Mr. Freer is willing to make present conveyance of the title to the collections to the Smithsonian, provided that he should retain the collections during his lifetime and that he should have the right to add to the collections such material as might seem necessary for their improvement.)

"The exact form of the bequest or gift, and the details for carrying it into execution, are legal questions that can be agreed upon by counsel representing the Institution or the Government and myself.

"I am, with great respect, very sincerely yours,

(Signed) "CHARLES L. FREER."

On January 24, 1906, the Smithsonian Regents passed resolutions formally accepting the gift, "recognizing the great value to the people of the United States of the art collection so generously offered by Mr. Charles L. Freer, of Detroit, Michigan." On May 5 of that year, the title to the collection, containing at that time some 2,250 objects, was conveyed to the Smithsonian Institution. This was but the beginning of the matter, however, for Mr. Freer, having retired in 1900 from an active business life, began to devote more and more time to the development of his collections along the lines already described. The result was that from time to time he made large additions, until in 1915 the value of the art objects was nearly tripled. As for the building, he was finally led to increase the sum for its erection to $1,000,000.

Some interesting facts regarding Freer's early life are given by Mr. J. Oliver Curwood in an article in the *International Studio:*

"When about twenty-five, Freer was working in Logansport, Indiana, as a clerk on a railroad of which he afterward became auditor. At this time his chum and roommate was Col. Frank J. Hecker, who afterward became a

Panama Canal commissioner. Fortune did not smile upon these two for a long time. They worked on the Eel River Railroad, an enterprise that consisted of thirty miles of track, sixteen freight cars, six passenger coaches, and two locomotives. . . . In those days Freer and Hecker . . . cooked their meals over an alcohol stove in their rooms to curtail expenses. Both were exceedingly attached to the little road, and by the time Freer became auditor Hecker was its superintendent. Their one train wobbled daily from Logansport through Mexico and Chili, two Miami County towns tropical only in name. There was only one conductor, and often one of these two men would help him out. The train stopped at crossroads, cornfields, anywhere that a passenger might choose to stand and wave his hands. So Freer learned the names of hundreds of men, women, and children—their habits and the location of their homes. . . . In 1878 the little road was leased to the Wabash and such costly appurtenances as auditors and superintendents were discontinued. It was a great blow to Freer and his chum. When they were thrown out of employment it looked as though fate were against them, but as a matter of fact the loss of their positions made them both millionaires. Between them they had saved several thousand dollars, and together they came to Detroit. In those days there were no car shops in the Middle West, so Hecker and Freer rented a building and began building cars on a small scale. To this company they gave the name of the Peninsular Car Works, which afterward became famous all over the world. Their business developed beyond their wildest dreams. Their 'shops' grew larger and larger, they paid for their buildings, erected others, and soon were counted rich men. A few years ago the company was purchased by the car trust, and both Freer and Hecker went out of it at a gain of several millions each."

Following his generous offer to the Nation in 1906, another idea began to develop in Mr. Freer's mind. In

April, 1908, Secretary Charles D. Walcott wrote to Mr. Freer, stating that there might be a possibility of securing an appropriation from Congress to erect a gallery building if Mr. Freer felt that he would be willing to relinquish his art treasures during his lifetime and turn them over to the Nation in a year or two. Mr. Freer's reaction to this suggestion is very interesting, and later developments show that the idea thus implanted in his mind never became dislodged. He wrote:

"Your suggestions excite great possibilities and appeal deeply to my higher ideals. Still, I must tell you frankly that from the very first my wish has been to retain possession and absolute supervision of the collections as long as I live.

"Perhaps the time has come when I ought to make some self-denial in order that students, art lovers, and the general public may have such access to these works of art as can be afforded by their permanent housing and exhibition in the National Capital. To accomplish this purpose I am willing, though with a feeling of no little personal regret, to cooperate with you. . . ."

Nothing, however, came of the plan of requesting Congress to provide a home for Freer's generous gift, but the notion of putting his collections where they would be accessible to students and the art-loving public became stronger and stronger with Mr. Freer. In 1915 he came to a decision, and waiving his right to retain possession of his art works during his lifetime, he decided upon the early erection of the building and the transfer of the collections to Washington.

In December, 1915, Mr. Freer turned over to the Smithsonian the sum of $1,000,000 for the erection of the building, and Mr. Charles A. Platt, of New York, was selected as the architect. The location of the building at the southwestern corner of the Smithsonian grounds, on the corner of Twelfth and B streets southwest, was approved by the Fine Arts Commission, plans were prepared and

approved, and the formal laying of the cornerstone took place in the fall of 1916.

It was expected that approximately two years would be required for the completion of the building, but shortly after work was started, America entered World War I, and progress thereafter was necessarily slow. In fact, the building was not entirely completed and ready to receive the collections, by this time numbering well over 6,000 objects, from the executors of the Freer estate, until late in 1920, four years after the laying of the cornerstone.

The building which Mr. Freer provided to permanently house his art treasures is an architectural masterpiece. Constructed of pink granite in the style of the Florentine Renaissance, the exterior is both dignified and pleasing. Measuring 228 feet in frontage by 185 feet in depth, it is of modest dimensions though imposing through its simple dignity. Its single main story consists of a number of individual interconnecting galleries of various sizes, surrounding an open central court approximately 65 feet square. This court is one of the beautiful features of the building. It is entirely open to the sky and faced on all sides by covered corridors. The court itself is laid out with walks, gardens, and fountains, and for a time a number of live peacocks lent a touch of exotic beauty.

The galleries themselves are arranged with the greatest care so as to secure the best possible lighting, background, and general effect. Each artist represented is given, where practicable, an individual gallery, in order that his work may be considered as a whole rather than in part. The basement contains the administrative offices of the staff, carefully designed studios, an auditorium for lectures, and storage rooms.

In 1919, with the building drawing on toward completion, Mr. Freer was taken ill, and his death came on September 25, 1919. Regarding this sad event, Doctor Holmes, then Director of the National Gallery, wrote:

Chinese bronze ceremonial vessel of the Chou dynasty, 1122 to 255 B.C. In the Freer Gallery of Art

"That Mr. Freer was not permitted to see the consummation of his plans for the development of the art interests of the country is greatly deplored. His experience and advice would be invaluable in inaugurating this independent unit of the National Gallery of Art which he so generously provided. The building and collections represent an outlay of some six or seven million dollars and constitute one of the most important and valued donations which any individual has ever made freely and unconditionally to the Nation."

It is indeed most regrettable that Mr. Freer, having first wished to retain his collections during his lifetime and later having decided with great unselfishness that they should be placed at once where they would be readily available to all, should not have lived to see the fruition of his generosity and the enjoyment and benefit which thousands yearly now derive from his gift to America.

Work on the building went forward, however, and in June, 1921, the Institution formally accepted it from the architect, Mr. Platt. The Freer collection had already begun to arrive in Washington from the executors of the estate in the November preceding, and on June 15, 1921, receipt in full was acknowledged by the Smithsonian of the entire collection. The appointment of Mr. John Ellerton Lodge as Curator had already been announced, and assisted by Miss Grace D. Guest and Miss Katharine N. Rhoades, he entered at once upon the difficult task of classifying, cataloguing, and installing the great collection.

This work occupied the greater part of two years, and in 1923, during the week of May 2, the Freer Gallery of Art was formally opened to the public. This date will in the future be looked upon as a milestone in the progress of art in America. There was now in Washington, as a unit of the National Collection of Fine Arts, an unrivaled collection of American and Oriental art, assembled with a definite purpose and a definite ideal,

with a beautiful building to exhibit it to the best advantage, the whole standing as a magnificent gift from a patriotic American citizen to the American people. The formal opening brought forth widespread comment from the press and from art journals, paying all honor to Mr. Freer for his great benefaction.

To give a brief idea of Mr. Freer's aim in assembling his collection and of the collection itself, I cannot do better than quote what the Curator, Mr. Lodge, has written:

"The collections installed in the Freer Gallery of Art, were brought together by Charles Lang Freer, of Detroit, Michigan. They represent the results of Mr. Freer's personal study and acquisition over a period of about thirty-five years, the earliest of his purchases incorporated in the collections dating from the later eighties. It was not until after 1900, however, when at the age of 46 he retired from an active business life, that Mr. Freer was able to devote the greater part of his time to the development of his collections and of the ideals which lay behind them. From 1900 until the time of his death in September, 1919, he gradually eliminated from his consideration all other activities which might absorb his time and strength, in order that he might work with increasing concentration on his endeavor to establish the beginnings of what he believed to be a most valuable field of research.

"Mr. Freer was convinced that the more nearly a cultural object of any civilization expresses the underlying principles of artistic production in soundness of thought and workmanship, the more nearly it takes its place with other objects of equally high quality produced by any other civilization; and with that in view, he was intent upon bringing together such expressions of Western and Eastern cultures as seemed to him to embody at their best those characteristics which he believed to be inherent in all works of art.

"From the West, he acquired principally American

The Chinese Taoist Immortals, Han-Shan and Shih-te. Painting by Gaho, Freer Gallery of Art. Attaining immortality by their successful quest for the elixir of life, they are laughing together over the blank scroll of Nature, in derision at what they know is destined to be written upon it

PLATE 58

A gallery in the Freer Gallery of Art

paintings by men, inheritors of European traditions, in whose work he found qualities and tendencies sympathetic with those of earlier painters in China and Japan. Most important in the Western field, as represented in these collections, is a section devoted to the work of James McNeill Whistler, including oil paintings, water colors, pastels, etchings, lithographs, engravings, drawings, and also the Peacock Room, which has been removed from the house in London where it was decorated by Whistler for Mr. F. R. Leyland. In the American field there are also representative groups of paintings by Thomas W. Dewing, Abbott H. Thayer, and Dwight W. Tryon; and examples of the work of George de Forest Brush, Childe Hassam, Winslow Homer, Gari Melchers, Willard Metcalf, John Francis Murphy, Charles A. Platt, Albert P. Ryder, John Singer Sargent, and John H. Twachtman.

"From the East, he gathered paintings, potteries, sculptures in stone, in wood and in lacquer, bronzes, jades, and objects of various other materials. The Chinese field is represented by the largest number of objects covering the longest period of time. Some of these specimens were produced as early as the Chou Dynasty (1122-255 B.C.) and some of them were made as recently as the Ch'ing Dynasty (A.D. 1644-1912). The Chinese paintings number over 1,200, including panels, scrolls, and albums; and the Japanese paintings, about 800, including also screens. The potteries from the Far East,—China, Japan, and Korea,—number about 1,500; the stone and wood sculpture, 273; and the bronzes, including several specimens from Siam, about 900.

"From the Nearer East, Mr. Freer purchased miniature paintings and illustrated books of Persian origin, Persian and West Asian potteries, many of them of Rakka type, and a few specimens of bronze and silver. Muhammadan art is further exemplified by a number of East Indian paintings.

"Dynastic Egypt is more slightly represented by a

collection of small pieces and fragments of glass and pottery and by a few objects in metal, wood, and stone.

"The most significant Byzantine objects appearing in the Freer collection are the Greek Biblical Manuscripts, which were found in Egypt. The most important of these, now known as the Washington Manuscripts, are Deuteronomy and Joshua, the Psalms, and the four Gospels, all of which date from the fifth century, and a fragmentary manuscript of the Epistles of Paul, which dates from the sixth century."

One of the chief features of the whole Freer collection is the famous "peacock room," decorated by Whistler for Mr. F. R. Leyland in London. The room is said to have been designed primarily as a setting for the picture, "La Princesse du Pays de la Porcelaine," which occupies the place of honor. The entire room is decorated in the peacock motif, and is called a "Harmony in Blue and Gold." The room was dismantled, shipped across the ocean, and is set up in the Freer Gallery exactly as originally designed by Whistler. An interesting account of the purchase of this room by Mr. Freer was given in the *International Studio* by Mr. J. Oliver Curwood, who incidentally shows us one of Mr. Freer's personal characteristics:

"In nothing has Mr. Freer's dislike of newspaper notoriety been more emphasized than in the incidents surrounding the purchase of the peacock room decorations. When Leyland died, connoisseurs in England pleaded that the room which had been painted for him by Whistler should be purchased by the Government and 'installed in a public gallery for the pleasure and education of the coming generations.' While thousands were pleading this cause, no one came forward to offer the necessary funds, nor were the men arguing for the preservation of the room willing to contribute. But at this time there disembarked at Liverpool, an American—a scholarly-looking gentleman, with quiet, unostentatious manners, and a Van Dyke

South end of the famous Peacock Room, done by Whistler, now installed complete in the Freer Gallery of Art

beard. Although a millionaire many times over, he did not advertise the fact. He went quietly to London, quietly inspected the peacock room, quietly wrote out a check for $63,000, and then quietly stole back to Liverpool again, and quietly set sail for America.

"By the time he was on the sea, art circles in England were stirred up by such a storm as they had never before experienced. England had been robbed of one its greatest art treasures. The news was cabled all over the world, and incidentally to New York. From Boston, Philadelphia, and other large cities near the coast, newspaper men came to meet Mr. Freer.

"Coming across the sea the great collector racked his brain to find a way in which he might escape the promised newspaper notoriety. He evolved a scheme. It was afternoon when the boat arrived, and Mr. Freer had the rumor spread that he was not feeling well, and would not land until morning. The newspaper men dispersed to get their suppers and await the coming day. Then very quietly, Mr. Freer walked down the gangplank. Quietly he entered a cab, drove to the railway station and bought a ticket for Detroit. And the next day Mr. Freer was many hundreds of miles away. And this is why, Mr. Freer now relates for the first time, there were no big newspaper stories about him at that time."

The last will of Mr. Freer provides a large endowment fund. Besides the gradual increase of his collections along the lines laid out in his own collection, the will makes provision for promoting "the study of the civilization of the Far East and the appreciation of high ideals of beauty." In furtherance of these objects, the Freer Gallery in 1923 joined with the Museum of Fine Arts, Boston, in sending an archeological expedition to China under the direction of Mr. Carl Whiting Bishop. This expedition carried on fruitful investigations at various localities in China, including the opening of a number of interesting and instructive mounds and tombs. The most far-seeing

work of the expedition so far was the establishment of a cooperative agreement with the Chinese authorities with regard to archeological investigation, confirmed by the appointment of Mr. Bishop as Honorary Adviser in Archeology to the Historical Department of the Chinese Government The continued work of this expedition added valuable material to the collections and greatly promoted those studies of Far Eastern civilization proposed by the terms of the will.

To summarize the value of Mr. Freer's munificent gift to the Nation, I will quote Carroll, who just before the actual beginning of the building in 1916, wrote in *Scribner's Magazine:*

"Donor and architect together are now planning the details of the museum that is to open new fields of study, to which limits may hardly be set. . . .

"Egypt, Babylonia, Assyria, Mesopotamia, Persia, China, Korea, Japan—the history of the ancient world recorded by itself, preserved by Mother Earth and in temples, palaces, tombs, and the treasure-chests of Celestial generations: a history written in terms of art and of domestic and political life, in objects of daily use enhanced and exalted by the imaginative, the creative mind and skill of the artist and the artisan. This history the museum is to open to scholar and artist, to specialist and public, proffering to all the elevating influences of ancient attainments by diverse peoples."

The first Director of the Freer Gallery, Mr. John E. Lodge, died in 1942 and was succeeded by Mr. Archibald G. Wenley.

CHAPTER X

WHAT PEOPLE WANT TO KNOW

LETTERS from every manner of man on every subject under the sun make up the Smithsonian's daily mail. It is a definite policy of the Institution to try earnestly to supply whatever information may be requested, so long as it can be brought within the scope of the Smithsonian's work. Next to its publications, which are distributed throughout the civilized world, its correspondence is the Institution's most effective means of diffusing knowledge. Since its establishment in 1846, hundreds of thousands of letters have gone out to those seeking information. They now average 8,000 annually. Members of the scientific staff devote a considerable part of their time to this work of supplying information to correspondents, for often an apparently simple question will require several hours of research for an adequate answer. A little later I will give samples of the typical letters answered daily by the scientists of the Institution and its branches, but first let me mention another type of letter which appears frequently in the Smithsonian's mail.

These are the letters from non-scientific persons who believe they have made great discoveries regarding the laws of the universe; from cranks with a grudge against the world, who refuse to believe any of the fundamental truths of science; and from those obviously of unbalanced mind, who apparently think that at the Smithsonian they will at least get a sympathetic hearing for their weird ideas. To letters of this class, of course, no serious con-

sideration is given, though they are usually acknowledged and placed on file under the general heading, "Out of scope." A few examples will best illustrate this class of letters which are received almost daily at the Institution. Astronomy is a favorite topic in these letters, as shown by the following:

"If a man represent the sun, will he be like the earth equatorially centered and fixed by the opposing attractions of his north and south poles? N. B.—Of course a man is not the sun. This is merely an illustration."

Again:

"Smithsonian Institute,
"Washington, D. C.

"Gentlemen:

"As I regard your Institution the proper one to consider new theories advanced, I wish to submit one to you for your careful consideration.

"I dispute the old theory of the control of the tides by the moon; I claim that there must be a force within the earth responsible for the tides, and I have named this force which I believe exists, anti-gravity.

"It seems very unreasonable to me that the earth and the moon should each be pulling on the other, yet never coming together. I believe this force—anti-gravity—is a force within the earth, the same as gravity is, only exerting its power to repel bodies of a size that would be dangerous to this earth, to keep them at a safe distance from the earth. This force of anti-gravity keeping the moon at a proper distance from the earth is the force that causes the swell in the earth and ocean known as tides. The ebb and flow, I maintain, is simply, the action and reaction of opposing forces. . . .

"This theory explains to me why comets that are reported coming towards the earth never get dangerously near. They are deflected by the force of anti-gravity. . . .

"I believe the sun exerts exactly the same forces on

the planets of our solar system, and it is these forces pushing and pulling that keep the planets in their orbits.

"Anti-gravity also exerts a little more force on one side of a body than on the other, hence the rotating and revolving of the bodies.

"Respectfully,"

An anonymous letter, giving the details as to why the author refuses to consider the earth a globe, is interesting if somewhat inconclusive:

"To the Wise Men of the Smithsonian Observatory, Greeting:

"The surface of the earth—taken as a whole is Flat and Stands Fast. Take a level straight datum line—as engineers do—and tell us all you can about true astronomy. It is time to overthrow that globe-earth-in-rotation delusion. There is not any truth in it. You should not be the last men to wake up.

"The earth—at its surface—taken as a whole is Flat and Stands Fast. This is science and can be proven. See the works by civil engineers—in their works—in their long level straight datum lines—to and from which they work in building waterworks, canals, and railroads. Their works prove the earth is flat—when taken as a whole.

"Observations of the sun for navigation are taken from a level straight datum line.

"Science shows the Sun is only 32 miles in diameter north to south. Science shows the Sun is only 2,700 miles from the earth. Vertical rays of the Sun are only 32 miles—north to south. 11,000 students yearly are taught Flat Earth Astronomy at a University in Cairo, Egypt.

"Wake up Americans! Give us true and scientific facts about Astronomy."

A considerable proportion of the Institution's mail each day consists of requests for its publications. With the limited editions which the Institution is able to print of

its papers, it is not possible to maintain a mailing list of individuals. The papers as they come out are usually reviewed in the newspapers, and a heavy correspondence invariably follows. Some of the requests are very amusing. For example, a young man writes in that he is about to be married and is very anxious to get a complete set of the *Smithsonian Reports* in order to fill a new bookcase. A little boy asks the Smithsonian to please send him a book (contents not specified) as he has a stepfather and ought to have one—presumably as a sort of antidote. Another request frequently received is for any publication, regardless of its nature, that is free. While some letters are very specific as to just what kind of publications are desired, others allow the widest latitude in selection. The man who sent the following request evidently did not intend to overlook any possibility:

"Smithsonian Institution,
"Washington, D. C.

"Dear Sirs:

"Will you please tell me how I can get the publications published by you on the following subjects:
"Geology
"Biology
"Botany
"National Museum
"National Gallery of Art
"Bureau of American Ethnology
"Indians
"International Exchanges
"National Zoological Park
"Astrophysical Observatory
"And any other interesting subjects."

Had it been possible to send that writer all that he desired he would have received several thousand volumes and pamphlets.

A corner of the great hall in the Smithsonian Building, where is displayed the index exhibit summarizing all Smithsonian activities

Smithsonian Institute
Washington (Mr. Abbott.)
Gentlemen,
From the Ether, Magellan Clouds
centered = Galaxy.
Mass, centrifugated, cooled &
centred = Sol.
Planets were thrown from its Equator
Plus & Minus.
+ = Mass as to mass.
— = Radiation as to distance
& Surface — Examples
Mercury - Mass & Radiation —
Saturn — Surface —
Peri & aphelion. Cinnr Galaxy — Scorpio - Galaxy
Example Neptune = 18 × Jupiter under
similar Galactic attributes.
Sol stands this pull — North & South —
Period ½ Synodical ♃ & ♄.
= 9.93 years.
Asteroids, Meteors & Globe of Ice =
Frozen Planet —
Example — Eros —
Cold = Pressure = Perpetual motion.
Patents Ballasting.
Sails
Craft
Power
Transportation
(no help,
no money,
& laziness).

Sample of curious letters addressed to the Smithsonian Institution that do not increase knowledge. Many such letters are received every year

Another request recently received is remarkable for the diversity of subjects desired:

"Dear Sir:

"A friend told me that U. S. Govt. had a book or bulletin on ASTRONOMY, and on candy making, which would be sent for postage.

"I do not know how much postage would be required, but am herewith enclosing you an 8 cent stamp for which send me first choice of all ASTRONOMY, and if I have sent enough also include the one about Home Candy Making, and if still enough send book on care of the hands, face, skin or beauty culture and oblige."

Aside from the serious requests for solid information, there are also received a great number of requests for miscellaneous information, sometimes to settle a bet, to decide an argument, or merely to satisfy the writer's curiosity. Some of these are not easily answered offhand, as for instance the following received from a man who was obviously in some educational contest. The letter requested accurate replies to the following list of questions:

"1. What is the size of the Sahara Desert?

"2. How wide is the River Nile?

"3. For whom is Mt. Helena, in the State of Washington, named?

"4. What is the circumference of the earth in the 60th circle of latitude expressed in nautical miles?

"5. Name the largest pyramid in Mexico and state its size.

"6. What was the nearest that the planet Mars approached the earth and when?

"7. Where are the two chief points of largest production of asbestos?

"8. Where is the largest Sulphur mine in the world?

"9. Where is the geographical center of the United States?

"10. What city is called the 'Mother of the World'?"

Along this same line, several newspaper syndicates which conduct columns of "questions and answers" refer to the Institution many of the queries on scientific subjects which they receive.

All of these various kinds of letters are, of course, offshoots from the main purpose of the Institution's correspondence, which is to supply information for some useful purpose to college professors and school teachers for use in the class room, to the students themselves, to research workers who need certain specific data in their investigations, and to the general public seriously seeking information on scientific matters. Many such requests are received and answered every day, and it is of this class of correspondence, forming one of the Institution's most effective means of diffusing knowledge, that I will now give a few samples. The letters group themselves into a number of classes: those relating to the American Indians are answered by the Bureau of American Ethnology of the Institution; those seeking information on biology, geology, anthropology, and the arts and industries are referred to the National Museum; the letters dealing with questions of astronomy, meteorology, and physics are replied to by the staff of the Smithsonian Astrophysical Observatory; and all matters relating to art are answered by the officials of the National Collection of Fine Arts and the Freer Gallery of Art.

The correspondence bearing on the American Indians is very heavy, owing to the great and growing popular interest in the aboriginal American race. With the recent development of our western National parks, increasing numbers of tourists yearly visit these regions and view personally the wonderful cliff dwellings, pueblos, and other habitations of the ancient tribes. The Bureau of American Ethnology is recognized as headquarters for authentic information on the Indians and all sorts of questions are asked about them—their language, customs, beliefs, myths, pottery, and artifacts. So many letters are

received requesting the meaning of certain Indian words and asking for suitable Indian names for clubs, camps, cottages, boats, and estates, that it has been necessary to publish a "Circular of information regarding Indian popular names." This circular contains personal names used by ten different tribes, camp names in several Indian languages, and a list of books on Indian folk-lore, myths, and legends. During World War I, the linguists of the Bureau staff were frequently called upon to censor letters written home in their native dialect by Indian soldiers in the American Expeditionary Forces.

The two following letters selected at random from among thousands of similar ones in the Bureau correspondence files will show the nature of the inquiries received and the replies sent:

"Secretary,
"Smithsonian Institution,
"Washington.

"DEAR SIR:

"For some years I have been actively interested in Cultural Anthropology as a member of the mine-megalithic school of thought, and at the moment am interested in the origin of the American Indian.

"Could you possibly give me any information as to whether any of the tribes claim divine origin for their rulers, or whether any of the chiefs have had, or now have, a title equivalent to Child, or Son, of the Sun, and,

"Have you any knowledge of the Indians placing a religious significance upon an association of the swastika and serpent?"

The reply:

"It is known that a number of American tribes claimed divine origin for their rulers, believing them to be descended from the great heroes of remote antiquity. Especially prevalent was the belief that the ruler was descended

from the Sun. Among the ancient Peruvians the title of Inca or Ruler was 'Son of the Sun,' and among the Natchez of the Mississippi Valley the Chief was called outright 'The Sun,' without using the word 'son.'

"Among the Indians the swastika is to be regarded as a form of the cross. The cross is found among the tribes with considerable variation of form and is most commonly explained by the Indians as symbolizing the four cardinal directions and therefore the whole universe. Among the Pueblos it stands also for the roadrunner's footprint, which shows four toes, two branching forward and two backward, so that the hunter seeing the tracks cannot tell in which direction the bird is going. This was given a mystic interpretation by the Indians, signifying the past and the future, and that the past and future are one and the same thing and equal to the four directions and to the world. The serpent, on the other hand, symbolized fertility, water, and life. It is the Quetzalcoatl of the Aztecs, the Kulakan of the Mayas. This divine serpent was worshiped by nearly all the tribes. I have learned of it in California and it even occurred in the beliefs of the Algonquian Indians in the eastern United States. It inhabits the waters of the sky and was worshiped with special ceremonies by the Pueblo Indians and others.

"No chiefs at the present day term themselves sons of the Sun, but formerly some did so."

Another typical letter recently requested information regarding the serpent mounds left by the prehistoric Indians, and was answered as follows:

"There are several serpent mounds in our country but the Great Serpent Mound in Adams County, Ohio, is the most typical and the best known. So great was the interest in it that several years ago through the efforts of the late Prof. F. W. Putnam, of Cambridge, it was made a public park under the direction of the Peabody Museum of Harvard College. Later it was transferred to the

State of Ohio and is now under the jurisdiction of that State.

"The scientific literature on the Great Serpent Mound is rather large and we have many descriptions of it, one of the most concise of which was printed in the 'Handbook of American Indians,' *Bulletin 30* of this Bureau. The 'Handbook' is no longer available for distribution, but an excerpt of this article is enclosed herewith.

"The interpretations of the Serpent Mound have been various, no one doubting that it was a representation of the great serpent that played such a prominent part in the religions of all the aborigines of the American continent. The serpent in the religion of our Indians was not regarded by its votaries as associated with moral evil but as a beneficent god of the sky, associated with the sun in Sky God worship, and prayers to it were for increase of life, and expressed the desires of agriculturalists for the fertilization of their corn seeds. We find it symbolized in the southwestern part of the United States and throughout aboriginal Mexico as a great beneficent god known as the Plumed Serpent, from the fact that in personations and idols of it in their secret rites, this being has a serpentine body, with a horn and a bunch of feathers on the head. In the more highly developed rituals of the Maya and Aztec people it is sculptured on the walls of their great temples devoted to worship of the sun.

"The Serpent Mound in Adams County as described in the accompanying excerpt from our 'Handbook' is a long mound of earth in the form of a partially coiled serpent, the head having certain significant features. The end of the body enlarges into two extensions reaching forward, one on each side of the low oval mound which is surrounded anteriorly by an elevation of breastbone shape fitted around this oval, by some authors called an egg. The snake is supposed by these interpreters to be represented as swallowing an egg of gigantic size. Others, however, believe that this oval mound represents the sun

which was always associated with the Plumed Serpent in aboriginal worship.

"The above deals more especially with the Great Serpent Mound in Adams County, but there are other reptilian mounds as the one on the Ohio River opposite Portsmouth, Kentucky, which was figured long ago by Messrs. Squier and Davis, who were pioneers in the study of the mound builders of the Mississippi Valley and who wrote a classic work on archeology, the first one published by the Smithsonian Institution.

"You will find good descriptions of the Serpent Mound in the 'Archeological Atlas of Ohio', by William C. Mills, published by the Ohio State Archeological and Historical Society, Columbus, 1914, and 'The Serpent Mound of Adams County,' by C. C. Willoughby, *American Anthropologist*, n. s., Vol. 21, pp. 153–163. You will also find other references to the literature of the Mound in the enclosed article."

The letters referred to the specialists of the staff of the National Museum for reply cover every imaginable subject bearing on natural history and anthropology, and they number thousands every year. The few typical examples presented here represent geology, biology, and anthropology. The larger part of the correspondence of the department of geology relates to the identification of specimens of rocks, minerals, and earth sent in. While the Museum has no facilities for making commercial analyses or assays, nevertheless it is usually able to identify the specimens, thus often saving the correspondent the expense of having an assay made of worthless mineral or ore. A large proportion of the material sent in is iron pyrites, commonly known as "fool's gold." The superficial resemblance of this mineral to real gold leads many persons to believe that they have "struck it rich," and the Museum has been forced to disappoint many a prospective mine owner. Many other minerals are submitted, however, and the two following letters prepared by members of the

Museum staff will show the nature of the information sent out in reply. The first describes a pale-yellow stone resembling a diamond found in New York State:

"Dear Sir:

"The cut stone is what is known in the jewelry trade as citrine, and this, mineralogically, is quartz or common rock crystal. This has long been used as a cheap gem. Its hardness is sufficiently great so that it wears well and retains its polish. Such stones have been called Herkimer diamonds, Barrie diamonds, Lake George diamonds, etc. In general they are rather monotonously white stones, lacking the fire and play of colors of true diamonds. Clear stones of this kind are common in many parts of Arkansas, especially in the vicinity of Hot Springs, as well as at many other places, as in Herkimer County, New York; North and South Carolina; and Brazil. This same mineral substance forms amethyst when purple, and much of what is sold as white or smoky topaz is quartz. Your pale-yellow stone is a true citrine and is of more interest than if it was white. As far as we can determine, it has not been subjected to any artificial process. Many lapidaries cut such stones.

"We may state here that real 'Arkansas diamonds' are genuine diamonds and some are the same color as the specimen sent."

The other letter selected from the geology department describes the interesting stone known as chalcedony:

"Dear Madam:

"The stones are more or less waterworn pieces of chalcedony, with the exception of No. 7 which has the coloring which makes it onyx (not to be confused with Mexican onyx which is a different substance). These stones are all forms of silica and differ from quartz only in internal structure. They commonly occur as a decomposition product of basic volcanic rocks. These volcanic rocks are often filled with steam cavities formed by bubbles of

expanding gases when they were in a molten condition. Surface waters decompose the substance of these rocks and dissolve out a part of the silica, to deposit it later in the bubble cavities in a gelatinous form which gradually hardens to form what is known as chalcedonic silica. Various coloring matters may be deposited with this silica giving rise to various colors and patterns in the final chalcedony, forming agate, carnelian, sardonyx, onyx, moss agate, etc."

In biology, the variety of the inquiries is very great, covering animals, birds, insects, and general matters pertaining to biology. The question as to the date of the extinction of various birds is frequently asked, as in the following letter:

"Gentlemen:

"As a matter of scientific research won't you kindly tell me the date (as exactly as possible) of:

"1. The extinction of the Great Auk
"2. Passenger pigeon
"3. Carolina Parokeet
"4. Dodo."

This inquiry was answered thus:

"Dear Sir:

"Acknowledging the receipt of your recent inquiry as to the date of extinction of certain birds, Dr. C. W. Richmond, our Associate Curator of Birds, makes the following statement:

"1. Great Auk: About 1848.
"2. Passenger Pigeon: September 1, 1914, in captive state. About 1903 in the wild state.
"3. Carolina Paroquet: May not yet be completely extinct. We do not know.
"4. Dodo: Existed until 1681 or later, but its exact year of extinction is unknown."

The next letter typifies the numerous requests received for biological information of a general nature:

"Smithsonian Institute,
"Washington, D. C.

"Gentlemen:

"Would appreciate greatly your answers to the following questions:

"1. How are young opossums born and raised?
"2. Are animals color blind?
"3. What are the facts about hoop snakes; *i.e.*, their method of travel, are they poisonous, and can they kill trees by striking them?
"4. What three animals (besides man) are considered the most intelligent?
"5. Are the water moccasin and cotton-mouth snake the same?

"I shall be very grateful if you can give me an immediate reply."

And the reply was sent:

"Dear Sir:

"Receipt is acknowledged of your letter of March 9 and in response to your inquiry concerning opossums a copy of a pamphlet on the subject is being forwarded to you under separate cover.

"In response to your other inquiries Dr. Leonhard Stejneger, Head Curator of Biology, makes the following statements:

"Q. Are animals color-blind?
"A. No.
"Q. What are the facts about hoop snakes, *i.e.*, their method of travel, are they poisonous, and can they kill trees by striking them?
"A. Hoop snakes do not exist.
"Q. What three animals (besides man) are considered the most intelligent?
"A. Opinions differ; perhaps ape, elephant, and dog.

"Q. Are the water moccasin and cotton-mouth snake the same?

"A. Water moccasin and cotton-mouth are names for the same poisonous snakes occurring in the southern United States, but 'water moccasin' is used in many localities for the large nonpoisonous water snake."

Entomology is a very popular subject, and countless specimens of all kinds of insects are sent in to the Smithsonian for identification. The senders often request information regarding the insect submitted, and the replies to this class of inquiry are usually quite interesting from a natural history point of view, as shown in the two samples given below. Usually the specimens are offered to the Museum for its collections, and although the insect collection is one of the largest in the world, numbering millions of specimens, nevertheless occasionally a rare species is acquired in this way. The following letter and reply are typical of hundreds of others:

"Smithsonian Institution,
"Washington, D. C.

"Gentlemen:

"I am today sending you, by parcel post in a metal container, packed in mold from rotten wood, ten grubs and two mature beetles, supposed to be of the same kind.

"This beetle is of a variety practically unknown in this part of the country, these two being, except one other which was found in this county over thirty years since, all I have ever seen. These insects were found in an oak tree recently cut and which had much decayed wood in the heart.

"I desire that you write me upon receipt and examination of these insects, stating the name of them and where they are usually found and whether or not they are rare. Personally I have worked at cutting timber and clearing land for cultivation quite a good deal in my early man-

hood and have always carefully observed insects, reptiles, plants, etc. encountered in this part of the country, and because of that habit of observation and interest in such things, I am sending you the specimen referred to and asking for the information."

This letter was referred to the specialist in beetles, who furnished the following information:

"Dear Sir:

"The beetles and large grubs are *Dynastes tityus* Linnæus, the largest of our few kinds of native 'rhinoceros beetles,' which is very seldom found in any numbers, but is known to live throughout the southern States. It is a close relative of the 'Hercules beetle' of tropical America which attains a length of about 6½ inches, but whose horns are more slender. In all the species of the genus *Dynastes* the females have no horns on the head and prothorax and are usually smaller than the males, so that they are seldom recognized as the same species. No real use for the horns of the males is known.

"The adult beetles feed on sweet juices, such as overripe peaches or other fruit, but also have the habit of tearing the bark of ash trees and drinking the exuding sap. The eggs are supposed to be laid in hollow trees, where the young grubs live for two to perhaps several years before making pupal cells and maturing under the conditions described by the sender.

"A curious case of annoyance from this beetle has been reported from Mississippi. A village street bordered by ash shade trees smelled so strongly of the musky odor of the beetles attracted to the trees and feeding on the sap that much comment was aroused.

"This species is often mentioned and pictured in popular works on beetles, and also in numerous technical notices. Perhaps the sender may have access to some of the following books: [list follows]."

Another insect frequently made the subject of inquiry

is the "doodle bug," and the following is an example of the popular information supplied:

"Dear Madam:

"The 'doodle bug' is a well-known insect, especially in the Middle West. You have probably read James Whitcomb Riley's poem about when his uncle visited him. The books generally refer to this insect under the name of ant lion, and you can probably find references without difficulty by looking up the term. In the adult stage the insects are of very different appearance, being very slender, long and delicate-looking, quite a good deal like a dragonfly (snake feeder), but have very distinct knobbed antennæ. The larva is a short, fat little insect with long jaws and lives in dry sand or earth, where it makes a conelike depression by throwing up the dust with its jaws. It lies concealed in the bottom of this cone and when insects running along accidentally get over the edge and slide down in, it snaps them up, drags them back into the dirt, where they cannot struggle, and sucks out the juice. There is a tradition, as recorded by Riley in his poem, that if the word 'doodle, doodle,' is repeated close over the depression, the little insect will put its head out of the sand."

In the department of anthropology, as in that of geology, a large proportion of the correspondence consists in identifying and describing specimens sent to the Museum by the owners. The brief letters given here are good examples of hundreds prepared yearly for those requesting such information.

"Dear Sir:

"Referring to previous correspondence and particularly to your letter of February 25, I beg to acknowledge the receipt of the two scarab pins therein mentioned. They have been examined by Dr. I. M. Casanowicz, Assistant Curator of Old World Archeology, who furnishes the

PLATE 63

Colonial room in the National Museum, presented by Mrs. Gertrude D. Ritter. The panelled walls were taken bodily from the old Bliss house in Springfield, Massachusetts. All of the furnishings are authentic pieces dating between 1760 to 1780

information given below concerning them. They are returned to you by registered mail.

"1. Good-wish scarab (Egyptian *Nefr*), wishing good luck.

"2. Phoenix (Egyptian *Benu*), the bird which is one of the emblems of the sun god (Ra) and in whom the soul of Osiris, the ruler of the netherworld, lives.

"3. Phoenix, with the feather, the symbol of Maat, the goddess of truth.

"4. Scarab, emblem of Kheperi, one of the 'creators of mankind.'

"5. Engraving very crude and indistinct. Perhaps Bes, the god of domestic joy and merriment.

"They are nice scarabs and may be placed between 2500 and 1500 B.C. The National Museum does not appraise objects, least of all such as the present sending, which have no standardized price. They are worth the best price obtainable from one who takes a fancy to them."

Some of the American Indian artifacts sent for identification are not always what they seem, as illustrated by the following letter:

"DEAR SIR:

"The two necklaces which you transmitted on December 13 have been examined by Dr. Walter Hough, of the Department of Anthropology, who reports that the black-and-white one is from the South Pacific and is the native manufacture of shell and cocoanut. Attached to it is an Eskimo foreshaft of a small harpoon. The other necklace somewhat resembles the work of the Pueblo Indians, but as the beads are of bone and accurately cut, Doctor Hough is inclined to think them the work of the whites. The string is made of tanned leather, and is apparently a shoestring. Nevertheless, the necklace may have been worn by the Plains or Pueblo Indians."

The arts and industries department of the National

Museum answers every year hundreds of requests for information on the most diversified subjects. So wide is the variety that I will not attempt to give examples, since it would be necessary to cover inventions, mechanical devices, the mineral industries, mining, engineering, textiles, medicine, organic chemistry, woods and their uses, American history, coins and medals, stamps, guns, watches, and many other subjects.

A great many inquiries are received at the Institution regarding astronomy and physics, and such letters are answered by the staff of the Astrophysical Observatory. Many of these can be adequately treated by referring the correspondent to the "Smithsonian Physical Tables," a volume of several hundred pages containing a large amount of valuable data used in astronomy, physics, chemistry, and engineering. Much of the correspondence in these subjects is of a highly technical nature, but often a layman will request enlightenment on some astronomical matter. Such a letter is presented here:

"Dear Sir:

"I can't quite grasp what the parallax of a star is, or how it is calculated, and then how distances are calculated. Would it be asking too much for you to draw me an outline of how the parallax of a star is determined? Also, what is a parsec? Have wondered if it is the distance of a star with one-second parallax."

The Institution's answer was as follows:

"Dear Sir:

"If you stand before a window and look across the street at a window on the opposite side, your line of sight to the two edges of it will make a certain angle. Similarly, if you could stand upon a star and look upon the orbit of the earth around the sun, the radius of that orbit when at right angles to your line of sight would make a certain angle. This is the parallax of a star.

"The trigonometric method of measuring parallaxes now

commonly employed is to photograph the star at intervals of six months, when the earth is at opposite sides of its orbit. Then, since the star in question is always a bright one rather near, it will be found to be displaced with reference to the little extremely distant ones whose parallaxes for most purposes may be neglected. The angle of displacement will bear a certain relation to the parallax, depending upon the time of the observation with respect to the rotation and revolution of the earth.

"A parsec is, as you suppose, the distance of a star whose parallax is one second."

Examples could be multiplied indefinitely in all of the branches of science, but enough have been given to show the great variety of scientific subjects treated in the Smithsonian's correspondence. As stated above, a considerable proportion of the time of the entire staff of the Institution and its branches is devoted to this work, and a considerable number of clerks are required to handle the routine work connected with the correspondence. Many of the letters contain several pages of closely written script, often difficult to decipher, requiring quite a little time to even read; others are models of brevity, this characteristic approaching perfection in a letter recently received in reply to a communication from the Institution, in which superfluous language is reduced to a minimum:

"Dear Sir:

"Yours 21st. Good. "Very truly yours,"

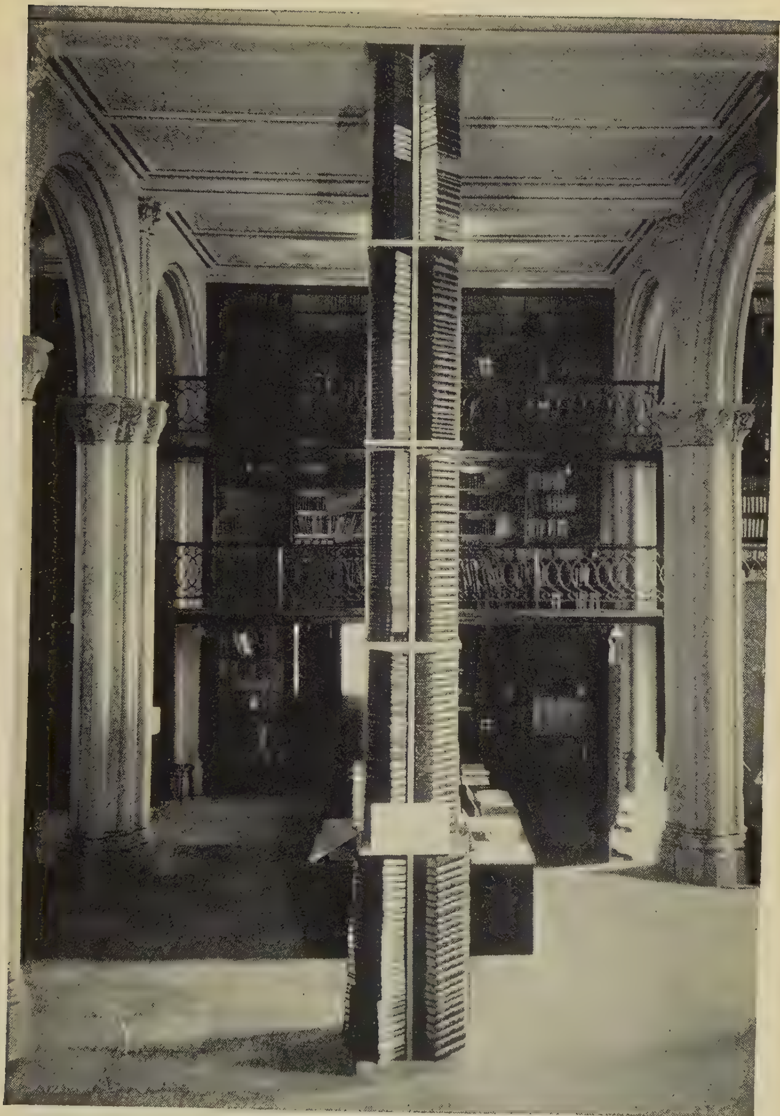
It would be impossible to estimate the number of letters which the Institution has received—it is enough to say that two large rooms filled with file cases are required to hold them. At the present time the letters requesting information number about 8,000 each year, and this number is increasing steadily as more and more people learn of the ability and willingness of the Smithsonian to supply authentic information on scientific matters.

CHAPTER XI

WHAT THE SMITHSONIAN PUBLISHES

UNTIL a few years ago there stood in the great hall of the Institution a column twenty-three feet high, built not of marble but of books. They stood foursquare, making a fourfold column, volume upon volume. A sign informed the visitor that among these books there were no duplicates, but each volume contained either one or many publications by the Smithsonian Institution which had each been distributed, gratis, to 1,500 libraries and scientific societies in all countries of the world. Every publication bears upon its binding the torch, symbol of enlightenment, and on its title-page the great seal of the Smithsonian carrying the words: "For the increase and diffusion of knowledge among men."

The books and pamphlets printed by the Smithsonian Institution and its branches during the past fourscore years would in fact form a good-sized library, and there is no branch of science that would be missing on its shelves. The items would range in size from little pocket leaflets to ponderous quarto monographs of a thousand pages and over, and they would cover the alphabetical classification of the major divisions of science from aeronautics to zoology. Furthermore, the sciences are treated in two distinct styles, the technical and the popular, so that no class of seekers after scientific information would come away disappointed from this library. To carry the figure a little further, the reading room of the library of Smithsonian publications would be frequented by two distinct types of visitors; one, the specialist in some branch



One side of the 4-section book column 23 feet high that formerly stood in the Smithsonian Main Hall, composed of all Smithsonian publications in every field of science issued from 1846 to 1927

PLATE 65

Illustration reproduced from the first publication of the Smithsonian Institution, "Ancient Monuments of the Mississippi Valley," by Squier and Davis, published in 1847. A drawing of the great Indian mound at Marietta, Ohio

of science who needed the information contained in certain of the technical papers for use in his own researches; and the other, the average intelligent citizen, alive to the value of science and research in modern life, who wished to read of the progress in the various branches of knowledge presented in such a way that he could understand and enjoy it.

If such is the variety and wealth of the printing which has been done by the Institution "for the diffusion of knowledge among men," the far-flung army of the readers is not less remarkable. As our exploring parties wander in distant corners of the world, in Asia, New Zealand, the Pacific Islands, or South America, they are often led with pride by the librarians of these countries to see upon their shelves the books stamped with the golden torch of the Smithsonian. Nor are the books left untouched to gather dust upon the shelves. On the contrary, they are eagerly sought, highly valued. Their valuable contents and free distribution to so many libraries and learned societies all over the world has given to the Smithsonian Institution an international prestige and respect second to no other institution.

James Smithson's broad definition of the Institution's functions, for "the increase and diffusion of knowledge among men," is well interpreted by his own activities. His whole life was devoted to conducting scientific investigations and to writing and publishing the results. There can be little doubt that in bequeathing his estate to the United States of America, he intended to provide for the perpetuation of this work. Accordingly for more than three-quarters of a century the Smithsonian has published not only the results of its own researches but those of others which it has deemed important to put into circulation. Copies of all these publications are distributed free to important libraries, learned institutions, and universities not only in this country but in every civilized nation on the face of the earth, and there is no research

center in the world where these works are not available to the student needing them.

To get at the nature and value of the contents of this great mass of published information, which if bound up together would make a volume of more than 400,000 pages, let us first put down the various series in which the papers appear, and then present some of the interesting features of each. They are:

Smithsonian Annual Reports
Smithsonian Contributions to Knowledge
Smithsonian Miscellaneous Collections
Smithsonian Special Publications
Annual Reports of the National Museum
Proceedings of the National Museum
Bulletins of the National Museum
Contributions from the National Herbarium
Annual Reports of the Bureau of American Ethnology
Bulletins of the Bureau of American Ethnology
Annals of the Astrophysical Observatory
Catalogues of the National Collection of Fine Arts

The *Smithsonian Annual Reports* are in a good sense popular, and, prior to this SERIES, formed our principal offering of that type. From twenty-five to thirty articles illustrating scientific progress make up the general appendix to each *Report*. They are selected especially for the nontechnical reader who is interested in following the marvels of modern science but is unable to decipher the technical language in the average scientific bulletin. Secretary Langley used to say that he aimed in the *Reports* to please the country schoolmaster, whose taste may be imagined if the individual himself has now almost ceased to exist.

Certain of the other series sometimes contain papers which, while not intended to arouse popular interest, happen to strike the fancy of the public, and rapidly become "best sellers." An example of this is a paper published some years ago describing the preliminary experiments of Prof. Robert H. Goddard, under the

auspices of the Institution, on high-flying rockets. The real purpose of the researches was to learn more about those layers of atmosphere surrounding our earth which have never been reached and whose composition and physical conditions are interesting, important, and unknown. In closing the paper, Professor Goddard mentioned the possibility of being able to propel one of these rockets, containing a quantity of brilliant flash powder, beyond the influence of our planet and to the surface of the dark part of the new moon, where the flash powder on impact would make a spot of light which, from theoretical calculation, should be plainly visible in the larger telescopes. This speculation was seized upon by the press, and made such a prominent feature in the daily papers that the Smithsonian for a time was deluged with letters. A large amusement park in Brooklyn offered its facilities as a starting point for the proposed rocket; a telegram was received from the Pacific coast from the press agent of one of the leading motion-picture actresses requesting that her greetings be enclosed in the first rocket to be dispatched to the moon; and to cap the climax, a daring gentleman called personally at the offices of the Institution and offered his services to be himself enclosed inside the rocket and propelled with it to the moon. He did not disclose his motives in thus desiring to risk his life in reaching other worlds, but it was thought possible at the Institution that some enterprising advertising concern might be planning to utilize this unoccupied space for bill-posting purposes.

The *Smithsonian Reports* are probably the most generally known of the Institution's publications, as the manner in which the material is presented makes them of interest to all intelligent persons and they are printed in large editions for wide distribution. At one time an effort was made to have the progress during the year in the various branches of science, as astronomy, geology, and physics, summarized in special articles prepared for

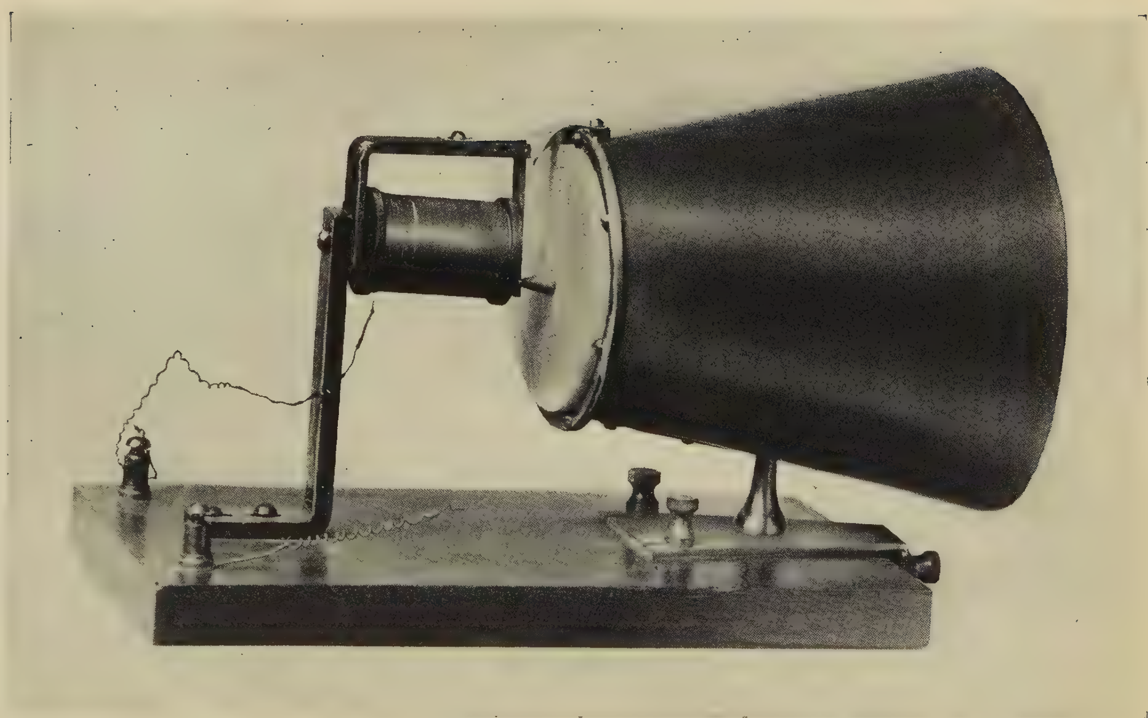
the purpose. This method was found not to be entirely satisfactory, and a return was made to the original plan, namely, to present a series of miscellaneous papers, some written especially for the *Report*, others reprinted from American and foreign journals, selected to present especially important and interesting advances in science during the year. Suggestions are invited from the scientific staff of the Institution and from its numerous correspondents and collaborators, and from among the hundreds of titles submitted, the twenty-five or thirty best suited for the purpose are picked.

To give an inkling of the wealth of interest of papers in the *Smithsonian Reports:* We find a translation of Röntgen's original description of the X-rays; Eugene Dubois's discovery of *Pithecanthropus erectus;* and Millikan's account of the measurement of the electric charge carried by a single ion, among the original-discovery papers. Then we find Langley's and the Wright brothers' own stories of pioneering in aviation; a translation of Delitsch's fascinating account of discoveries among the ancient palaces and temples of Mesopotamia; Amundsen's first Northwest passage; many papers on the wonders of modern astronomy; Snodgrass' charming insect descriptions; Walcott's account of the most ancient fossil remains; Mason, Fewkes, and others on the Indian arts of architecture, basketry, pottery, and weaving; Hollister on the animals of the National Zoo. In short there is endless variety combined with reliability and rich illustration.

To show that the people of America are alive to the importance of keeping up with the march of research and discovery, it is interesting to note that a cataloguer in the office of the Superintendent of Documents at Washington, where all Government publications are distributed, recently placed the *Smithsonian Report* at the head of a list of all public documents arranged in the order of their popularity judged by the number of libraries requesting to receive them.

Geometric designs on prehistoric pottery from the Mimbres Valley, New Mexico, illustrative of the perfect regularity achieved without mechanical aids

PLATE 67



The type of instrument submitted by Alexander Graham Bell with his application for a patent on the telephone. Now in the National Museum

It has been noted elsewhere that the first scientific manuscript offered to the Institution for publication was the work of Squier and Davis on the "Ancient Monuments of the Mississippi Valley; Comprising the Results of Extensive Original Surveys and Explorations." This now famous monograph formed the first volume of the series, *Smithsonian Contributions to Knowledge*, of which there were issued thirty-five volumes. The requisite for publication in this series was that the manuscript submitted must form a positive addition to human knowledge, resting on original research. Each manuscript proposed for the *Contributions* was examined by a commission of experts in the branch of learning treated and accepted only if its report was favorable. The series was printed in quarto form, but after 1916, with the greatly increased costs of publication and with the restricted means of the Institution, it was found impracticable to issue any papers in this more expensive form.

It would be impossible to review the contents of the *Contributions to Knowledge* in a brief space, but perhaps an adequate idea of the scope and nature of the contents will be obtained by presenting a few representative titles. Many of the volumes consist of one monograph only, while others are made up of a number of smaller papers. Certain of the volumes contain the results of researches which have since become classic. The following titles are selected at random to illustrate the wide range of subjects embraced in the *Smithsonian Contributions to Knowledge:*

Researches relative to the planet Neptune, by Sears C. Walker, 1849. Part of Vol. 2.

Contributions to the physical geography of the United States, part 1. On the physical geography of the Mississippi Valley, with suggestions for the improvement of the navigation of the Ohio and other rivers, by Charles Ellet, Jr., 1850. Part of Vol. 2.

An account of a collection of plants made by Charles Wright in western Texas, New Mexico, and Sonora, in the years 1851 and 1852, by Asa Gray, 1852. Part of Vol. 3.

Grammar and dictionary of the Dakota language, by S. R. Riggs, 1852, Vol. 4.

Magnetical observations in the Arctic seas, by E. K. Kane, 1859. Part of Vol. 10.

The gray substance of the medulla oblongata and trapezium, by John Dean, 1864. Part of Vol. 16.

A contribution to the history of the fresh-water Algæ of North America, by H. C. Wood, Jr., 1872. Part of Vol. 19.

The winds of the globe; or, the laws of atmosphere circulation over the surface of the earth, by J. H. Coffin, 1875. Part of Vol. 20.

The internal structure of the earth, by J. G. Barnard, 1877. Part of Vol. 23.

The venoms of poisonous serpents, by S. W. Mitchell and E. T. Reichert, 1866. Part of Vol. 26.

Experiments in aerodynamics, by S. P. Langley, 1891. Part of Vol. 27.

Life histories of North American birds, vol. 1, by C. Bendire. Vol. 28.

On the densities of oxygen and hydrogen and on the ratio of their atomic weight, by E. W. Morley, 1895. Part of Vol. 29.

Argon, a new constituent of the atmosphere, by Lord Rayleigh and W. Ramsay, 1896. Part of Vol. 29.

The whalebone whales of the western North Atlantic compared with those occurring in European waters, by Frederick W. True, 1904. Vol. 33.

Langley memoir on mechanical flight, by S. P. Langley and C. M. Manly. Part 1, 1887 to 1896; part 2, 1897 to 1903. Part of Vol. 27.

It will be seen that no branch of science has been slighted in the *Contributions to Knowledge* series. In the other series of the Institution proper, the *Smithsonian Miscellaneous Collections*, the range is even wider on account of the much larger number of individual papers. The *Miscellaneous Collections* series now numbers well over 100 volumes, and some of the volumes have contained as many as forty individual papers.

The first issue of the *Miscellaneous Collections*, published in 1852, was "A Collection of Meteorological Tables, with Other Tables Useful in Practical Meteorology," by Arnold Guyot, designed primarily for the meteorological observers reporting to the Smithsonian Institution. It is a curious fact that among the very first activities of the Institution was the observation of meteorological conditions, organized by Joseph Henry, for the

purpose of foretelling the weather, and that the latest research of the Smithsonian, nearly a century afterward, is an attempt to contribute to the improvement of weather forecasting through the regular observations of the variations in the sun's radiation described in a previous chapter.

This volume of "Meteorological Tables" had a very important outcome. In itself it found a wide sphere of usefulness among meteorologists and physicists in the United States and in Europe, necessitating the publication of four editions. The last of these, appearing in 1884, was soon exhausted, and in preparing the next edition, the tables by this time having become very bulky, Secretary Langley decided to segregate the tables applying especially to other sciences into separate volumes. Thus from the original "Smithsonian Meteorological Tables," there now appeared three separate volumes, the "Smithsonian Meteorological Tables," the "Smithsonian Geographical Tables," and the "Smithsonian Physical Tables." These received prompt approval and soon became standard reference works for students in these subjects. They have gone through many revised editions and reprints, and are still in constant demand. There have since been added to the series of Smithsonian tables the "Smithsonian Mathematical Tables—Hyperbolic Functions," and the "Smithsonian Mathematical Formulae and Tables of Elliptic Functions."

The *Miscellaneous Collections* series was designed "to contain reports on the present state of our knowledge of particular branches of science; instructions for collecting and digesting facts and materials for research; lists and synopses of species of the organic and inorganic world; museum catalogues; reports of explorations; aids to bibliographical investigations, etc., generally prepared at the express request of the Institution and at its expense." All of these features and more are included in its more than 100 volumes. Papers on biological subjects have perhaps

predominated, many new forms of animal, bird, insect, and plant life having first been described in the *Miscellaneous Collections*. Although the great majority of the articles have been of a technical nature for the use of students, nevertheless a considerable number have been of interest to the general public. While it is very doubtful if the casual reader would pick up for an evening's entertainment a pamphlet with the title "A phylogenetic study of the recent crinoids, with special reference to the question of specialization through the partial or complete suppression of structural characters," on the other hand, anyone would enjoy reading and studying the striking illustrations of a recent paper on "Designs on prehistoric pottery from the Mimbres Valley, New Mexico," or a brief "History of electric light," illustrated by early inventions in the collections in the National Museum.

A number of Smithsonian publications have had an important economic bearing. For instance, a recent paper, although carrying the somewhat forbidding title "An introduction to the morphology and classification of the foraminifera," is nevertheless of vital importance to the oil industry. The foraminifera are minute marine organisms which occur abundantly in the present seas and as fossils in the rocks of earlier geologic times. They can be identified readily by specialists, and can be relied upon to indicate a desired layer of rock formation. When oil is struck in a certain stratum of rock, and borings are made to locate additional wells in the neighborhood, it is essential to know positively when this same stratum is reached. This is where the little foraminifera play their important part, for their very minuteness prevents their being broken and crushed beyond recognition in boring, as occurs with the other types of fossils encountered. The National Museum contains large collections of foraminifera, and many of the forms have been described in its publications. All of these papers have rapidly gone out of print through the constant demand for them, and the

paper of the forbidding title just quoted was specially prepared for the use of those engaged in the petroleum work and of the students now being trained in the universities for the work.

The papers in both the *Contributions to Knowledge* and *Miscellaneous Collections* series are issued as separate pamphlets, each with its own title-page. When a sufficient number of pages has been issued, a title-page, table of contents, and index for the volume are printed and distributed to all those who have received the pamphlets, so that they may be bound into volumes.

It is difficult to give in a brief space an adequate impression of the scope of a series such as the *Miscellaneous Collections*, which contains such a large number of articles on a wide range of subjects. It can best be summarized by repeating the "Advertisement" which appears with the preliminary pages for each volume:

"The present series, entitled *Smithsonian Miscellaneous Collections*, is intended to embrace all the octavo publications of the Institution, except the *Annual Report.* Its scope is not limited, and the volumes thus far issued relate to nearly every branch of science. Among these various subjects, zoology, bibliography, geology, mineralogy, anthropology, and astrophysics have predominated."

The 79th volume of the *Miscellaneous Collections* is entitled "World Weather Records." It illustrates in a striking way the high prestige of the Smithsonian Institution, the cooperative spirit which it evokes, and the worth-while character of its publications in fields that no private publisher could afford to enter. This book contains the monthly mean temperatures, barometric pressures, and precipitation for 387 stations well distributed over the whole world. These records were collected, in response to a resolution of an international meeting, by half a dozen of the world's most eminent meteorologists, from the official sources in the various countries. Many of

them were hitherto unpublished and inaccessible to scholars. They cover periods of from fifty to 150 years. The immense labor of editing was performed without remuneration by Mr. H. H. Clayton, a private individual not connected with the Institution. The cost of the printing, exceeding $10,000, was defrayed by another friend of the Smithsonian, Mr. John A. Roebling. So useful is the book to students of world weather and its influence on human life that within six months after publication the Institution began to receive requests for second copies from those who had actually already worn out their first copies in reference work.

All of the publications of the Smithsonian proper except the *Annual Report* are paid for from its own funds or funds donated by interested friends. The printing of the *Report*, which is required by law, is paid for from funds appropriated for the purpose by Congress, although the cost of preparation and editorial work is defrayed from the Smithson fund. All of the various publications of the Government bureaus administered as branches of the Institution, which now will be mentioned briefly, are paid for by Congressional appropriation.

The *Annual Reports of the National Museum*, although at one time enriched by the inclusion of numerous articles on the work of the Museum, often bringing the size of the books up to 1,000 pages and more, are at the present time strictly administrative reports on the collections and scientific activities of the Museum. The purpose of the next series, the *Proceedings of the National Museum*, is indicated in the following statement:

"Many of the objects gathered are of a novel and important character, and serve to throw a new light upon the study of nature and of man. The importance to science of prompt publication of descriptions of this material led to the establishment of the present series, the distinguishing particularity of which is that the articles are published in pamphlet form as fast as completed and

in advance of the bound volume. The articles in this series consist: first, of papers prepared by the scientific corps of the National Museum; secondly, of papers by others, founded upon the collections in the National Museum; and, finally, of facts and memoranda from the correspondence of the Smithsonian Institution."

The *Proceedings* contain descriptions of new species of animal life and of new minerals, accounts of collections, and revisions of the classification of various forms of life. Although only papers based on the collections in the Museum are accepted for publication, nevertheless there is always more material on hand for publication than there is money with which to print it. Inaugurated in 1881, there have been nearly a hundred volumes of the *Proceedings*, each volume containing from thirty to forty separate papers. Almost without exception the articles in the *Proceedings* are technical papers, and their distribution is limited to libraries, learned societies, and specialists.

The *Bulletins* of the Museum, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises, reports of expeditions, catalogues of special collections, and other large manuscripts of a nature not suitable for the *Proceedings*. Since 1902 there has appeared, as a part of the *Bulletin* series, the *Contributions from the National Herbarium*, which is devoted to papers on the botanical work and collections of the Museum. A series of papers of considerable economic importance was begun in 1918 and appeared in the *Bulletin* series. The general title of the series was "The Mineral Industries of the United States," and the individual papers dealt with the energy resources of this country—fuel and power—and fertilizers. In the foreword to this series, the authors state:

"Mineral resources are coming more and more into prominence as the basis upon which modern advance is built. Their adequate development is a matter of the

first importance and public opinion will be called upon in increasing measure to shape the course of advance in this fundamental field. As the general subject is not one of popular experience, this series is under preparation for the purpose of interpreting in nontechnical language the significant aspects of each resource of mineral origin, in anticipation of a growing demand for concise summations of technical knowledge in a form adapted to current use."

The publications of the National Museum have from the first had a high standing in the scientific world, and their effect has been greatly to stimulate progress in science in this country and abroad.

As stated in a previous chapter, the function of the Bureau of American Ethnology is to conduct "ethnological researches among the American Indians and the natives of Hawaii, including the excavation and preservation of archeological remains, under the direction of the Smithsonian Institution." For the purpose of making available to the public the knowledge thus obtained, the Bureau for forty years issued *Annual Reports* in quarto form, containing in addition to the administrative report of the year, accompanying papers usually in the form of extensive monographs on some phase of Indian life; and *Bulletins* in octavo form, containing all of the other accounts of the Bureau's activities. At present the *Bulletin* series contains all the Bureau's scientific contributions. These publications have always been in great demand, as nearly everyone is interested in anything relating to the real aboriginal Americans—the Indians. The annual reports and bulletins which have been put out by the Bureau cover the entire range of activities of this interesting but fast-disappearing race, and the constant demand for them from specialists and laymen alike causes the small editions which it is possible to print from the funds at its disposal soon to become exhausted.

As in the case of the *Smithsonian Contributions to*

The Ghost Dance of the Western Indians—"Inspiration." From Mr. James Mooney's study, published by the Bureau of American Ethnology

Knowledge, perhaps the best way to convey an impression of the nature and wide scope of these publications will be to set down a dozen titles, selected haphazard:

The aborigines of Porto Rico and neighboring islands, by J. Walter Fewkes.

Handbook of aboriginal American antiquities, by William H. Holmes.

Blood revenge, war, and victory feasts among the Jibaro Indians of eastern Ecuador, by Rafael Karsten.

Handbook of American Indian languages, by Franz Boas.

Native cemeteries and forms of burial east of the Mississippi, by David I. Bushnell, Jr.

Chippewa music, by Frances Densmore.

Prehistoric villages, castles, and towers of southwestern Colorado, by J. Walter Fewkes.

Omaha dwellings, furniture, and implements, by J. Owen Dorsey.

The Eskimo about Bering Strait, by Edward W. Nelson.

The Ghost-dance religion and the Sioux outbreak of 1890, by James Mooney.

An introduction to the study of the Maya hieroglyphs, by Sylvanus G. Morley.

Pottery of the ancient Pueblos, by William H. Holmes.

Picture-writing of the American Indians, by Garrick Mallery.

Tusayan snake ceremonies, by J. Walter Fewkes.

Interest in all phases of Indian life is bound to grow more and more keen as time goes on, for in a few generations there will be no longer such a thing as an Indian race—they will literally have been absorbed by an advancing civilization. The tragedy of this vanishing of a once flourishing people is eloquently expressed in Edna Dean Proctor's poem, "The Song of the Ancient People":

> Words are dead and lips are dumb
> Our hopeless woe to speak.
> For the fires grow cold, and the dances fail,
> And the songs in their echoes die;
> And what have we left but the graves beneath,
> And above the waiting sky?

How the Indian himself felt about the encroachment of the white man on his territory is told by Washington Irving in the chapter on Philip of Pokanoket in the "Sketch Book":

"With a scanty band of followers, who still remained true to his fortunes, the unhappy Philip wandered back to the vicinity of Mount Hope, the ancient dwelling of his fathers. Here he lurked about like a specter among the desolated scenes of former power and prosperity, now bereft of home, of family, and friend. . . . Even in this last refuge of desperation and despair a sullen grandeur gathers round his memory. We picture him to ourselves seated among his careworn followers, brooding in silence over his blasted fortunes and acquiring a savage sublimity from the wildness and dreariness of his lurking place. Defeated but not dismayed, crushed to earth but not humiliated, he seemed to grow more haughty beneath disaster and to experience a fierce satisfaction in draining the last dregs of bitterness."

A series of publications of a very different type is the *Annals of the Astrophysical Observatory*. The principal work of the Observatory since the year 1902, as described in detail in a previous chapter, has been an investigation of the dependence of terrestrial affairs upon the incoming radiation from the sun and the outgoing radiation from the earth. The *Annals*, of which six large quarto volumes have been published, present in detail the conduct and results of these important studies. In the second volume, evidences of variability in the radiation of the sun are presented, although in that early stage of the work, methods and instruments had not yet been sufficiently perfected to draw very positive conclusions. As the work progressed, however, and the workers devised more reliable instruments and quicker and surer methods of computing the results of the observations, the indications of variability in the sun's radiation were greatly strengthened, until now with three first-class observing stations in daily operation on opposite hemispheres of the earth, there is no longer any doubt that the sun varies and that its variations can be accurately measured.

In the introduction to Volume IV, which covers the

years 1913 to 1922, the general conclusions reached up to that time and which have since been well borne out are briefly stated as follows:

1. The mean value of the intensity of solar radiation outside the atmosphere, measured over a sun-spot period, is about 1.94 calories per square centimeter per minute.

2. The sun is a variable star. Its variation is twofold. One variety is of long period associated with the variations of solar activity revealed in sun spots. The other variety is of short, irregular periods of the order of days or weeks.

3. The variations of the sun decidedly affect the earth's weather. There is indeed great hope that a study of them will yield results of value for forecasting purposes. There is great need of additional observing stations in the most cloudless quarters of the world to make a more thorough study of the solar radiation for this purpose.

4. The temperature of the earth is profoundly dependent on the humidity of the air and to a less degree on the quantities of ozone and carbon dioxide which the air contains. A partial knowledge of these dependencies has been obtained, but further investigation is needed.

Although the *Annals* consist very largely of highly technical accounts of the work and of tables of the actual observations, there is one chapter in Volume IV which is of very general interest and in great demand. This is a chapter on the utilization of solar energy, in which are described and illustrated the various devices invented by Eneas, Willsie and Boyle, Shuman, and others to harness the sun's energy directly to furnish power. There is also described here in detail Doctor Abbot's solar cooker with which Mrs. Abbot succeeded, to the great envy of the ladies of the neighborhood, in doing all sorts of cooking with no fuel expense and with the added pleasure of having the apparatus just outside the house, thus escaping the oppressive heat of a kitchen in summer.

The title of the last of the series of Smithsonian publications, the *Catalogues of the National Collection of Fine Arts,* is self-explanatory. Not until 1920 was the Collection made a separate unit under the Smithsonian, so that only two *Catalogues* have been issued to date. This *Catalogue* is one of the few instances in which the Institution has made a particular effort toward fine bookmaking. It is printed on antique, deckle-edged paper, the half-tone plates being done in sepia ink on a dull-coated paper, and the binding is a pleasing shade of blue buckram with the title and Smithsonian seal stamped in gold.

Having thus attempted to give a glimpse of the wide range embraced by the Smithsonian's publications, it only remains to tell briefly how they are distributed. This is not such a simple matter as it might appear at first sight. With the limited edition of each paper which the Institution is able to print, it is often necessary to weigh requests quite carefully, and it requires accurate judgment to determine who would be benefited and who would not by receiving a certain publication. Miss Helen Munroe, who for a number of years has been in charge of the distribution of all Smithsonian publications except those of the National Museum, has learned to discriminate very closely between the requests of specialists and those of the general reader in quest of knowledge who could derive no benefit from a highly technical paper. Sometimes it is an easy matter to decide, as for instance when a schoolboy writes, "Please send me some publications on anthropology," it is obviously unwise to send him a copy of a "Catalogue of measurements of human crania in the collections of the National Museum," or "Comparative lexicology of the Serian and Yuman languages." What he wants is more likely "Games of the North American Indians" or "Aboriginal pottery of the eastern United States," and a selection of this nature is made and sent to him. It is a rule of the Institution to make every effort to supply specialists with papers which

they need, but even this is sometimes difficult to determine with the attempt in mind to conserve the small editions and make them of the greatest possible service, as for instance, when a mining engineer writes for a copy of a paper on astrophysics and only one or two copies are left in the bins.

Perhaps the most difficult requests are those that are frequently received from correspondents unknown to the Institution, such as "Send me something on zoology." Now this leaves considerable latitude, as there are probably close to a thousand papers on zoology among the Institution's various publications, ranging from a two-page technical description of a new species of fish to equally technical monographs of several hundred pages on some large group of animals, as well as brief popular papers in the *Smithsonian Reports* describing the animals in the National Zoological Park. However, an attempt is made in every case to supply what is thought would do the most good, and the Institution often receives very appreciative letters from those who have received just the papers which would be of the most service.

Since 1846, there has been distributed from the Smithsonian to the four quarters of earth a total of at least 7,500,000 copies of its publications on every subject in the experience of man, and there is little doubt that this program of "diffusion of knowledge" would be a matter of the utmost gratification to the founder, James Smithson, could he but know of it.

CHAPTER XII

EXPLORING TO THE ENDS OF THE EARTH

Smithsonian exploring parties have worked on every continent, in nearly every country, and in practically every state of the United States. In fact, in many sections of this country, the belief is firmly fixed that all exploring and investigating parties are either from the Smithsonian or acting as its agents. There is a flavor of romance in the word explore, little as romance is associated in the popular belief with any scientific undertaking. While it is true that the scientific explorer is primarily on the trail of cold facts, nevertheless the out-of-the-way corners of the earth that he is in the habit of visiting are usually inaccessible, wild, and sometimes dangerous. For example, read Charles M. Hoy's letter from the interior of China, where he was engaged in 1923 in making zoological collections for the National Museum through the financial assistance of Dr. W. L. Abbott:

"Bandits are everywhere overrunning the country and very little is being done to check them. Even those bandits that derailed a train, in Shantung, and captured twenty-six foreigners and over three hundred natives, whom they held for ransom, have gone unpunished. In fact you might say that they were rewarded, for they were enrolled, *en masse*, into the army! Such things just tend to make the bandits, in other parts, all the bolder. Last week a Catholic priest was kidnaped from near Hankow, and he is now being held for ransom which is fixed at $1,000,000 (Mex.) or sixteen thousand rifles.

Travel, anywhere through China is, of a consequence, not without a certain amount of danger, but I am going ahead with all my plans and trust to luck in getting through. If I am caught, all that I ask is that nobody ransom me. I don't believe in encouraging the blighters."

A few months later, after escaping the attentions of the bandits, Hoy writes:

"The day after writing my last letter to you from Iningchow [never received], I had a bad fall and wrenched my back. For a week I was scarcely able to crawl about. Just when my back was getting so I could straighten up I had another accident and shot myself through the left leg with the Colt 45 automatic. The accident was due to a 'hang fire.' . . . The wound is healing nicely but the doctor says that it may be several months before I get full use of my foot and that I will most likely have a slight permanent limp. However, I am hoping that it won't interfere with my collecting, but even if I won't be able to do much walking myself, I have one man who is a crack shot with the shotgun and another that is fair with the rifle, so I ought to be able to get specimens anyhow."

Misfortune followed Mr. Hoy, however, for a few months later he died following a hurried operation for appendicitis. The natural history specimens which he collected in China and on a previous expedition to Australia, many of them now on exhibition in the halls of the National Museum, will stand as a monument to his zeal and ability as a collector.

The many hundreds of expeditions, large and small, which the Institution has had a part in, group themselves into two main divisions; those in which the Smithsonian has cooperated with other agencies, and those conducted entirely under the auspices of the Institution itself. Because of the limited funds available, the first group has been much the larger. Cooperation has taken various forms, such as supplying a portion of the necessary funds,

furnishing men who have the requisite training and knowledge, and providing outfits, instruments, and available information.

Perhaps none has been so famous as the Roosevelt African Expedition of 1909. The idea originated with President Theodore Roosevelt and the selection of naturalists to represent the Smithsonian was made by Secretary Walcott, who raised by subscription from friends of the Smithsonian about $30,000 to finance the scientific field work, including the collection, preservation, and shipment to America of the specimens. The expert preparation of the groups of animals which now distinguish the mammal hall of the National Museum was done in part by the Museum taxidermists and in part by Mr. Edgar Clark of New York at Museum expense. After the publication of the more popular books on the expedition by Colonel Roosevelt and Mr. Heller, the late Mr. Ned Hollister, then assistant curator of mammals in the National Museum, afterwards Superintendent of the National Zoological Park, prepared a scientific monograph on the enormous number of animal specimens secured. A portion of the correspondence between Roosevelt and Secretary Walcott will give us a vivid impression of the greatness of this expedition.

"Oyster Bay, N. Y.,
"June 20, 1908.

"My dear Dr. Walcott:

"About the 1st of April next I intend to start for Africa. My plans are of course indefinite, but at present I hope they will be something on the following order:

"By May 1st I shall land at Mombasa and spend the next few months hunting and traveling in British and German East Africa, probably going thence to or toward Uganda, with the expectation of striking the Nile about the beginning of the new year, and then working down it, with side trips after animals and birds, so as to come out at tidewater, say, about March 1st. This would give

A critical moment in the Smithsonian-Roosevelt African Expedition in 1909. Courtesy of the Roosevelt Memorial Association

A hartebeest family mounted in their native environment in the National Museum. Collected by the Smithsonian-Roosevelt African Expedition

me ten months in Africa. As you know, I am not in the least a game butcher. I like to do a certain amount of hunting, but my real and main interest is the interest of a faunal naturalist. Now, it seems to me that this opens the best chance for the National Museum to get a fine collection not only of the big game beasts, but of the smaller mammals and birds of Africa; and looking at it dispassionately, it seems to me that the chance ought not to be neglected. I will make arrangements in connection with publishing a book which will enable me to pay for the expenses of myself and my son. But what I would like to do would be to get one or two professional field taxidermists, field naturalists, to go with me, who should prepare and send back the specimens we collect. The collection which would thus go to the National Museum would be of unique value. It would, I hope, include rhinoceros, giraffe, hippopotamus, many of the big antelope, possibly elephant, buffalo, and lion, together with the rare smaller animals and birds. I have not the means that would enable me to pay for the one or two taxidermists and their kit, and the curing and transport of the specimens for the National Museum. But, as I say, I doubt if the National Museum would ever again have the chance to get a collection which would be from every standpoint as interesting. Of course the actual hunting of the big game I would want to do myself, or have my son do; but the specimens would all go to the National Museum, save a very few personal trophies of little scientific value, which for some reason I might like to keep. Now, can the National Museum arrange, in view of getting these specimens, for the services of one or two field taxidermists, and for the care and transport of the specimens? Could the money be provided without Congressional action? If not, I would try to get Congress to act by authorizing the expenditure of the comparatively small sum necessary; or it may be that I would be able to get the Carnegie Institute to help. I shall send

a copy of this letter to Mr. Root, because of his connection with the Carnegie Institute. If the National Museum won't do anything in the matter, I may communicate with the American Museum of Natural History of New York; but, of course, as ex-President, I should feel that the National Museum is the museum to which my collection should go.

"With high regard,

"Sincerely yours,

(Signed) "THEODORE ROOSEVELT."

"Hon. Charles D. Walcott,
"Secretary, Smithsonian Institution,
"Washington, D. C."

"Belton, Montana,
"June 27, 1908.

"To The President,
"Oyster Bay, New York.

"DEAR MR. PRESIDENT:

"Your letter of June 20th, with a copy of a letter Dr. Cyrus Adler wrote you in reply, just received.

"I am immensely pleased at the thought of your collections coming to the National Museum, and it will give me the greatest pleasure to provide two taxidermists and their kit, and to arrange for the curing and transport of the specimens. I do not think Congressional action will be necessary.

"I leave in the morning for the Kintla Lake region and the Continental Divide, as most of the geological work has to be done above timber line.

"Thanking you most heartily and sincerely for the opportunity of securing the African material,

"I remain,

"Sincerely yours,

(Signed) "CHAS. D. WALCOTT."

"Juja Farm,
"Nairobi, British East Africa,
"17th May, 1909.

"To:—
"C. D. Walcott, Esq.,
"Smithsonian Institution,
"Washington, D. C.

"My dear Dr. Walcott:

"So far our trip has been very successful, but the expense has been greater than I anticipated. . . . In doing this kind of Natural History work it is absolutely necessary to have a large outfit; as one item alone, there are four tons of salt, and yet we shall use up all of it.

"So far we have collected and preserved some fifty or sixty skins of large game, most of them in excellent condition for mounting. They include Eland 1, Lions 7, (of these four are fully grown), Rhino 2, Hippo 1, Giraffe 3 (one of them being only a head, and the other two complete skins), and in addition, Zebra, Waterhog, Hyena, Cheetah, Leopard, Wilderbeest, Hartebeest, Grant's Gazelle, Thomson's Gazelle, Reedbuck, Duiker, Steinbuck and Dik-Dik, and Waterbuck and Impalla.

"Heller has done most of the big-game preserving; Dr. Mearns and Loring have aided him, and have made a great collection of birds and mammals. Three better traveling companions, or more energetic and efficient zoological collectors, I don't believe you would find on the broad earth. We are making, I think I can say, a great trip. . . . We shall come out of the Sotek country about the last week of July. Then I shall have to know whether you can go on with the trip, or whether it must then be brought to a close; for in the latter case, Kermit and I will continue as if it were an ordinary hunting trip, and while, of course, if I am able to prepare three or four good specimens of rare animals I shall forward them to the museum, it will be a far more difficult thing to do.

It seems to me that the work is going on so well that it ought to be continued. . . .

"Such really admirable work has been done, even in these three and a half weeks that it will be a pity to see it stopped. By the 1st of August I must know definitely what the situation is. I shall, about that time, cable you, and would want to hear from you, by cable, in return, so I register this letter.

"With hearty regards,

"Faithfully yours,"

(No signature.)

(From Theodore Roosevelt.)

"July 7, 1909.

"Colonel Theodore Roosevelt,
"Nairobi,
"British East Africa.

"My dear Colonel Roosevelt:

"I was immensely interested in reading your letter, also those of Mearns and Heller. You certainly met with great success the first month, and I presume by the time this reaches you, you will have obtained large additions from the Sotek country.

"We were delighted to learn that all the party were well and having such a successful and pleasant time. We fully appreciate what you are doing for the national collections, and I will do all in my power to sustain the Expedition to the end.

"The skins will be carefully looked after on arrival here and all possible precaution taken to preserve them in good condition. . . .

"Sincerely yours,

(Signed) "Chas. D. Walcott."

"Naivasha, 23rd July, 1909.

"Dr. Charles D. Walcott,
"Secretary, Smithsonian Institution,
"Washington, D. C.

"My Dear Dr. Walcott:

"Your telegram about the deposit of the ten thousand dollars came as a great relief. We can now go on till the first of October. . . . But now I am happy to say that if you found you could give no more money, the results of the trip would still be satisfactory. Mearns and Loring have collected thousands of birds and small mammals, reptiles and so forth, not to speak of plants; and by October 1st, they will have thoroly worked the Kenia region. Meanwhile, Heller has secured for you, and by August 5th will have shipped to you, a collection of large mammals such as has never been obtained for any other museum in the world on a single trip. We have, for instance, a group of thirteen lions, which possibly may be reduced to ten because, as I told you, I may want one or two trophies for myself. We have a group of six giraffe, one of three or four buffalo, five rhinoceros, in addition to skeletons, four hippos in addition to skulls and skeletons, and similar groups of zebra, wilderbeest, spotted hyena, striped hyena, cheetah, leopard, wart-hog, hartebeest, topi, impalla, waterbuck, sing-sing waterbuck (single individual), Grant's gazelle including the variety Roberts's gazelle, Thomson's gazelle, reedbuck, steinbuck, duiker, dik-dik, clipspringer, baboon, and so forth. In the next two months, I shall try for elephant, but I am not very hopeful of getting them until we reach Uganda. If we do, however, get them prior to October 1st, then even if you find no more money can be sent, the trip will be a thoro success from the National Museum standpoint. But the great prize of the trip from the zoological standpoint will be the white rhinoceros from the Lado Enclave country, and I earnestly hope that if nothing else could be done, you would arrange enough money to have Heller

go with me. This would give you the elephant and white rhino groups, always provided that we have luck. However, I do hope that you will be able to arrange to continue the trip to Khartoum, for Loring and Mearns would do literally invaluable work in Uganda and the Enclave, and down the Nile Valley.

". . . This is necessarily an expensive trip, but I believe that so far it has also been a trip unique in its scope and its success. "Sincerely yours,

(Signed) "THEODORE ROOSEVELT."

"February 12, 1910.

"DEAR COLONEL ROOSEVELT:

"We are more and more pleased and delighted with the results of the expedition in your charge. The whole enterprise and its achievements are so thoroughly characteristic of yourself and of what we have known of your three associates, that nothing less was expected, were the fates kindly and if no untoward incident interfered with the execution of your well-matured plans.

"The Smithsonian African expedition will go down in history as one of the triumphs of American energy, training, and high ideals.

"The thoroughness of your preparations, and the resultant great success, have added to the belief of the American people that their trust and their confidence in you have been well grounded, and that whatever you undertake, whether for their welfare, for the advancement of knowledge, or for recreation, is the result of a sound physical, mental, and moral organization, and a clear conception of what you consider the right thing to do.

"I congratulate and thank you and all the members of the party.

"With my best wishes,

"Sincerely yours,

(Signed) "CHAS. D. WALCOTT."

"Colonel Theodore Roosevelt,
"Khartoum, Egypt."

Sha'läko, giant courier god of the Zuñi Rain-Makers. From a Bureau of American Ethnology study

The cooperative feature of the Institution's exploration work was of greatest importance during its early years at a period when there was still little known about our western States. Beginning about 1850, a few years after the founding of the Institution, the Government planned and sent out a number of transcontinental survey expeditions for the purpose of ascertaining the best routes for the proposed great cross-country railways and also to establish official boundary lines. This was an unrivaled opportunity for securing scientific data regarding the little-known parts of our country, the physical features of the regions themselves, and their fauna and flora. The Smithsonian made the most of this great opportunity, and either sent specialists with the various expeditions to obtain first-hand information, or provided apparatus for observing and collecting, and outlined the information that was needed for the regions traversed.

The title of this chapter, "Exploring to the ends of the earth," is not an exaggeration. Smithsonian explorers have penetrated the unknown places on the Western Hemisphere from Tierra del Fuego, on the tip of South America, to the ice-bound lands north of the Arctic Circle; and on the Eastern Hemisphere from the frozen steppes of Siberia to the sun-scorched plains of South Africa. The far-off islands of the sea have not been neglected, and Smithsonian expeditions have visited Australia, Borneo, Celebes, Sumatra, the Philippines, the Hawaiian Islands, the South Sea Islands, the Pribilofs, the Commander Islands, the islands in the West Indies group, and many others. If the biological, geological, and anthropological collections resulting from this dragnet spread over the surface of our planet were assembled in one place, they alone would fill a great Museum, and the published results would in themselves form an impressive series.

In the year 1911, the Director of the Smithsonian Astrophysical Observatory with a party and instruments occupied for four months a station located on the plateau some 50 to 100 miles directly south of Algiers in North Africa. Doctor Abbot had the good fortune to meet Director de Mestral of the École Roudil, near Ben Chicao, and to obtain from him permission to observe from a hill situated about one-fourth of a mile east of a little hamlet called Bassour, and to live in a four-room stone farmhouse in Bassour, belonging to the École Roudil. An account of the scientific work is given in another volume of this SERIES. Something of the conditions may be understood from the following extract from Doctor Abbot's report:

"With the exception of one French family, all of the neighbors during most of the four months' stay were Arabs. A screen door added to the house by the Americans, to hinder the entrance of houseflies, proved to have a no less valuable effect in keeping out uninvited visitors. [As an ordinary sample, one day eighty-three Arabs of all ages came to beg every article in sight.] Ancient methods of agriculture prevail in this region. Wheat is the staple crop. The ploughing is done with wooden ploughs, and the grain is threshed by treading out with oxen or mules, just as probably was done in the same country thousands of years ago. . . .

"A complete spectro-bolometric outfit was erected, including a small dark-room shelter for the photographic recording galvanometer. This shelter was built by Messrs. Abbot and Brackett out of packing boxes. The apparatus was the same that Doctor Abbot had used in 1909 and 1910, in his brief expeditions to the summit of Mount Whitney, California (4,420 meters). It is rather a new departure with the bolometer, that delicate instrument which measures the millionth of a degree rise of temperature, to use it out of doors, following the sun in an equatorial telescope, but Doctor Abbot successfully used it so in 1908 at

Flint Island in the South Pacific, in 1909 and 1910 at Mount Whitney, and now for several months in 1911 in Algeria."

In May, 1912, Mr. Ned Hollister of the divison of mammals, who afterward, as we have said, wrote the scientific descriptions of the Roosevelt collections, accompanied the Harvard University expedition to the Altai Mountains of Asia. The collecting was done chiefly on the Siberian side of the range, but expeditions were made to the Mongolian slopes for large game, and down to the Suok Plains, in the country of the Kirghiz. All this region is absolutely without trees and shrubs, and owing to its great altitude, is cold and stormy. A singular meteorological phenomenon in these mountains is the frequent occurrence of electrical hail storms. The severity of these storms and the display of electricity accompanying them is terrific. During the entire trip the party enjoyed only three days without rain or snow. The average altitude of camps here was from 8,500 to 9,000 feet, and above this plain the mountains rise to snow- and glacier-covered peaks of 12,000 feet or more. The country is wild, barren, and desolate; the only inhabitants, the nomadic Kirghiz and Kalmucks, are engaged in following their herds of yaks, horses, and goats.

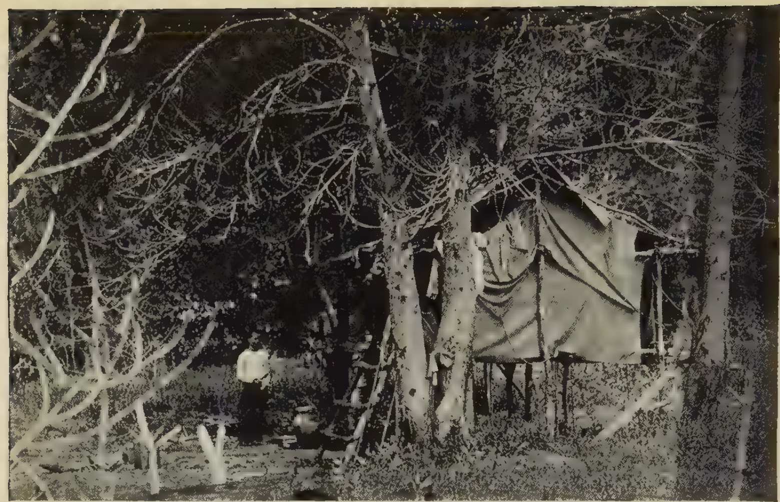
"On the return trip, stops were made on the Chuisaya Steppe and in the heavily forested Altais between the desert and the great Siberian plains. . . . The collections . . . include an almost complete series of the mammals and birds of this little-known part of Central Asia. Chief among the specimens of great game are four fine rams of *Ovis ammon*, the largest of all wild sheep. There are also specimens of two species of ibex and a gazelle. Thirteen forms of mammals collected are new to science, and some twenty others taken were not before represented in the collections of the National Museum. In all, about 650 mammals and birds were secured, and will be divided between the two institutions concerned."

Another typical zoological expedition was that undertaken during the years 1912 to 1915 in Borneo and Celebes, through the financial assistance of Dr. W. L. Abbott. In the following extract from a letter, the collector, Mr. H. C. Raven, describes his change of base from Borneo to the island of Celebes, 140 miles distant:

"As I wrote before, when I returned from the interior of Borneo to Samarinda, I had to have my boat, the *Bintang Kumala*, hauled out. It needed repairs and drying after having been in the water constantly for two years or more. The Assistant Resident stationed at Samarinda at this time went up along the coast to Beraoe, and I asked him to bring me two or three seafaring natives to act as a crew to cross with me to Celebes. He was unable to get them. I tried, but could find no Bajans or Soeloes who would go, but finally found, near Samarinda, three Bugginese who claimed they could sail. So when the boat was ready we started, and to my great disappointment I found my crew entirely incapable, running the boat ashore before we had gotten fairly started. There was nothing to do but to return to Samarinda. . . . Just at that time a small two-masted schooner came into Samarinda and my attention was called to it by a European who considered my boat unsafe to cross in. I had a look at the schooner and found it to be strongly built and in pretty good condition, fifty-four feet long and twelve feet beam, drawing about four feet of water. It is entirely of ironwood.

"After considering, I decided the best plan would be to buy the schooner, and as the owner was willing to sell, we came to terms. He bought my boat for 350 guilders and I was to buy the schooner for 1,350 guilders, but found that I could not own and sail a boat under the Dutch flag unless I had been holder of citizen's papers for a full year. According to Dutch law, coasting under a foreign flag is prohibited. Thus my only way was to make a contract of 'bond loan,' stating that I had loaned 1,350

Nogullo Negritos of Netherlands New Guinea, who had never seen a white man till the Stirling Expedition, under Smithsonian auspices and collaborating with the Dutch, penetrated the mountains to make the first extensive study of them



A—Raven's extemporized camp at Karang Tigan, Celebes, from which he made extensive collections for the Smithsonian

B—The problem of clothes is simple for this Dyak woman from the Segan River region, Borneo. Photograph by Raven for Smithsonian Institution

guilders to Hadji Mohamad Arsad and as security he gives into my absolute custody his schooner, which he may redeem only during the thirteenth month after date by paying the sum of 1,350 guilders, and must accept the schooner in any condition in which she may be at that time. . . . To find a crew for this boat was not difficult, and she is far better to handle than the smaller one and no more expensive to man—probably cheaper. Having crossed to Celebes in this boat, I should not care to do it in the smaller one, for Macassar Strait is 140 miles wide and over a thousand fathoms deep. A current running against the wind sometimes makes bad weather. Nearly all the coast of Celebes is rocky, with deep water close in to shore, so that in case of storm we sometimes have to run out to sea rather than chance going on rocks. In such cases it is exceedingly difficult in a small boat to keep anything dry."

Regarding the field collecting in Celebes, Mr. Raven writes:

"The country here is a great contrast to that of Borneo and mammal life not nearly so plentiful. . . .

"My traps I placed not far from the river, which at this dry season should be as good as any place. Nearly everywhere the shore is planted with cocoanuts and oftentimes clearings are made on the hill slopes, but inland the original forest remains unmolested, though it is not open forest like that of eastern Borneo. There is much underbush, composed principally of a variety of almost worthless rattan.

"Thus far I have collected specimens of babirussa (a pig with peculiar erect tusks curved backward above the forehead at extremities), two females with skins and some fine skulls of males. Also a peculiar black pig with hard cartilaginous conical nodules on its nose and hard jowl patches; a marsupial; and two species of squirrels. I have also seen a reddish squirrel running on the ground but have not gotten one; also I have seen a small carnivore.

Of rats I have six or seven species, and possibly there are more. I have also some bats. The ants do not seem to destroy as many rats here as in Borneo; this will prove a great advantage in collecting. . . .

"Reptiles appear to be common and the miners at Paleleh killed a python which they say *measured* ten meters (32.8 feet).

"Black macacus monkeys are generally common and at a distance look like black dogs. About the edges of the forest I have seen many birds, but in the deep forest I have seen very few."

Mr. Raven continued his work here until 1915, and the following year made another trip to Celebes through the continued assistance of Dr. W. L. Abbott, which lasted until 1918. These two expeditions, which resulted in large collections of the unusual animal and bird life of that little-known region, were of great importance to the National Museum, filling many gaps in its collections.

Near the end of June, 1912, Secretary Walcott left Washington for field work in British Columbia, to continue his studies in Cambrian geology and paleontology. He proceeded by way of Toronto on the Canadian Pacific Railway to Port Arthur and thence to Antikokan, near which point, on the shores of Steep Rock Lake, he hoped to collect the very ancient Algonkian fossils from the locality which had been discovered the summer before by Professor Lawson of the University of California.

He had hardly reached this station when he was saddened by a tragedy which nearly cost him his life. Going in a canoe with two companions, Trueman and Knox, to photograph Steep Rock Falls, they were crossing the river to get a better view when suddenly the canoe was swamped and all were thrown out. Doctor Walcott writes:

"As I went down with the swift current I had just one thought. It was not a great or ideal one, but good for the moment: Am I to die in this kind of a place? Not if

I can help it. I began to dog paddle with my hands and came up near the upset canoe and reached it. Knox called, 'Can you swim?' and I replied, 'No.' He then said, 'I will go ashore, get off my clothes, and come after you.' I glanced back and saw Trueman about ten yards back, swimming easily with a strong current. He could readily have landed, but followed the boat down to a big eddy. There a paddle drifted near and I got it. A moment later Trueman was at the other end of the canoe, apparently trying to push it toward shore. The canoe rolled over and I went under it, but came up and got hold of the stern and pulled up so as to use the paddle in one hand. I heard Trueman call and looked up and saw him about fifty feet away in the eddy, evidently treading water. A strong wind was bringing waves in from the lake and the canoe rolled over once more. When I got my head up, I heard Trueman call 'Help!' and saw his head way out. The eddy and wind swung the boat around and I saw nothing more of him. We landed in a few moments and Knox at once turned the water out of the canoe and was off searching for Trueman. No sign could be found. The water was very cold and probably he was taken with cramp or numbed. I could not stand for half an hour after landing and Knox shivered all over. Owing to having swallowed a lot of water, I could not call, and both Knox and I did not think of Trueman not easily reaching the shore. Knox worked like a hero, not a lost movement, and his first trip to relieve Trueman was very quick thinking. The horror of the event is such that I am unnerved and useless today. That such a promising life should be taken, with its future all before it, is incomprehensible. Trueman was true and brave, an honor to his science and to the organization he delighted in being a member of. Words are futile in the presence of such an event. I sorrow with all that loved and knew Trueman."

Dr. Walcott soon recovered from the effects of his

experience and continued his geological work, returning in the autumn as usual with large collections of specimens of the fossils of ancient life for the National Museum.

During the summer of 1912 Dr. Aleš Hrdlička visited, partly under the auspices of the Smithsonian Institution and partly in the interest of the Panama-California Exposition of San Diego, certain portions of Siberia and Mongolia in search of possible remains of the race that peopled America, whose home, according to all indications, was in eastern Asia.

"The studies of American anthropologists and archeologists have for a long time been contributing to the opinion that the American native did not originate in America, but is the result, speaking geologically, of a fairly recent immigration into this country; that he is physically and otherwise most closely related to the yellow-brown peoples of eastern Asia and Polynesia; and that in all probability he represents, in the main at least, a gradual overflow in the past from northeastern Siberia.

"If these views be correct, then it seems that there ought to exist to this day, in some parts of eastern Asia, archeological remains and possibly even actual survivals, of the physical stock from which the American aborigines resulted. . . .

"A visit was made to certain parts of southeastern Siberia and to northern Mongolia. It included Urga, the capital of outer Mongolia, which encloses two great monasteries, and is constantly visited by a large number of the natives from all parts of the country. Besides the field observations an examination was also made of the anthropological collections in the various Siberian museums within the area covered. The results were unexpectedly rich.

"Doctor Hrdlička saw or was told of thousands upon thousands of burial mounds or 'kourgans,' dating from the present time back to the period when nothing but stone implements were used by man in those regions. And he

saw and learned of numerous large caverns, particularly in the mountains bordering the Yenisei River, which yield human remains and offer excellent opportunities for investigation.

"In regard to the living people, there were opportunities of seeing numerous Buriats, representatives of a number of tribes on the Yenisei and Abacan Rivers, many thousands of Mongolians, a number of Tibetans, and many Chinese, with a few Manchurians. On one occasion alone, that of an important religious ceremony, 7,000 natives could be seen assembled from all parts of Mongolia.

"Among all these people there are visible many and unmistakable traces of admixture or persistence of what appears to have been the older population of these regions, pre-Mongolian and especially pre-Chinese, and those best representing these vestiges resemble to the point of identity the American Indian. These men, women, and children are brown in color, have black straight hair, dark brown eyes, and facial as well as bodily features which remind one most forcibly of the native Americans. Many of them, especially the women and children, if introduced among the Indians, and dressed to correspond, could by no means at the disposal of the anthropologist be distinguished apart. The similarities extend to the mental make-up of the people, and even to numerous habits and customs which new contacts and religions have not as yet been able to efface.

"As a result of what he saw, Doctor Hrdlička expresses the belief that there exist today over large parts of eastern Siberia, and in Mongolia, Tibet, and other regions in that part of the world, numerous remains of an ancient population (related in origin perhaps with the latest paleolithic European), which was physically identical with and in all probability gave rise to the American Indian."

Soon after the receipt by the Smithsonian of the great bequest of Mr. Charles L. Freer "for the promotion of the study of the civilization of the Far East and of the ap-

preciation of high types of beauty," the Institution, in cooperation with the Boston Museum, sent an expedition under the charge of Mr. C. W. Bishop to make friendly contacts with Chinese intellectual and official life, and to undertake such studies and collections of Chinese art and archeology as would carry forward Mr. Freer's intention. The expedition went forward in February, 1923, and continued its work for several years, employing not only Mr. Bishop, but several American and Chinese colleagues. Several interesting phases of the work appear in the following extracts from a letter from Mr. Bishop written August 13, 1926:

"It is truer now than ever before, that foreign enterprises, of any sort whatsoever, have not the slightest chance for success unless they operate with and through the proper Chinese organizations.

"I will spare you the wearisome details of negotiations, discussions, Chinese banquets, disappointments, and seemingly needless delays that have occurred.

"In China of all places it is no good saying what one is going to do a long time ahead. So far as one can plan, however, I hope that by the time the ground freezes in southern Shansi we shall be able to do the work we had planned along the Yangtse River.

"Peking has never in my experience been better governed, safer, or more contented than before the Mukden and other armies took possession. Soldiers behaved like gentlemen, paid for what they got, and were all off the streets at nine o'clock at night. Women, whether in the city or outside the walls, were unmolested; property was safe; and provisions came in in sufficient quantity and cheap in price. The moment the tide turned all changed. Robbery and burglary, even by broad daylight and in the Legation Quarter, are of daily occurrence, civilians are beaten with gun butts by the soldiery, the police are manhandled and even killed, and the condition in the surrounding villages is said to be indescribable; I haven't

Tule Indian women of Panama in native dress. Mr. John L. Baer of the Smithsonian Institution lost his life on the expedition to these Indians in 1924

been out to see for myself. The other evening, while driving in from a consultation over our Shansi trip, out at Tsing Hua, half a dozen soldiers stopped my hired car and began beating up the driver because he happened to pass too close to one of their number. I had only a light walking-stick; but language of which I retained a recollection from old mule-punching days in Sonora proved efficacious in clearing my running-boards."

The expedition was able to collect from ancient sites and from other sources a great many beautiful and valuable specimens, some of great antiquity and all highly interesting to students of Chinese culture. After having been four years almost constantly in the field, Mr. Bishop, while at sea on his return, described the situation he was leaving as follows:

"Mr. K. Z. Tung was to proceed in my place to Manchuria to represent the Freer Gallery and the Chinese Historical Museum at the somewhat important excavations to be undertaken there this month and next by the Kyoto Imperial University. He will then devote himself to keeping up our contacts, effected with so much difficulty during the past four years, with various Chinese organizations, communities, and individuals in a position to advance the cause to which we have been devoting ourselves.

"My four years in China on behalf of the Freer Gallery have been particularly fruitful of suggestions for the most profitable conduct of work in the future, both in the field and in the study.

"Probably the most important and at the same time the most delicate problem to be solved is that posed by the attitude recently taken by the Chinese scientific bodies themselves. China has been so shamelessly and so mercilessly looted of many of its art treasures by curio dealers, tomb robbers, and others that a very natural and thoroughly understandable feeling of resentment has been aroused. As you are aware, serious, and in some cases

insurmountable obstacles have during the past year or more been placed in the path of foreign organizations desirous of doing scientific work in China. This feeling is still as alive as ever, and just now Chinese national susceptibilities are more than wontedly tender. Thus you will see very easily why it is that more than one foreign expedition has come to grief of late."

This brief *résumé* of Smithsonian explorations can give only a meager impression of the broad scope and wide extent of the work. It has not been possible to mention in this short space many of the sciences in which the Institution has been active for many years, including botany, geology, ethnology, meteorology, oceanography, and others. It is hoped, however, that enough has been presented to show that the Smithsonian Institution has made every effort to carry out the wish of James Smithson to "increase knowledge," at the same time justifying the inscription on the great seal of the Institution: "*Per orbem*"—"Throughout the earth."

PART II

THE BEGINNINGS OF THE SMITHSONIAN INSTITUTION

CHAPTER XIII

JAMES SMITHSON AND HIS WILL

"*Promote, then, as an object of primary importance, institutions for the general diffusion of knowledge.*" — WASHINGTON'S FAREWELL ADDRESS, 1796.

JAMES SMITHSON was born in 1765, the natural son of Sir Hugh Smithson and Elizabeth Keate Macie, widow of James Macie, a country gentleman of Weston. During his early years, he bore the name of Macie, applying to the Crown for permission to assume his father's name after the death of his mother. It is quite necessary to speak of the circumstances of his birth, regarding which Smithson himself was not inclined to be reticent, as the sense of injustice, which he felt deeply, supplied, perhaps, the motive for his keen desire to perpetuate his name. This feeling appears in a sentence of his own:

"The best blood of England flows in my veins; on my father's side I am a Northumberland, on my mother's I am related to Kings, but this avails me not. My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten."

The father, Sir Hugh Smithson, was a striking figure, rising through sheer ability from the rank of a private gentleman to that of one of the leading peers of the kingdom, at a period of English history when such a feat was considered well-nigh impossible. In Westminster Abbey, where the elder Smithson is buried, is the following inscription:

"The most high, puissant, and most noble prince, Hugh Percy, Duke and Earl of Northumberland, Earl Percy, Baron Warkworth and Lovaine, Lord Lieutenant and Custos Rotulorum of the Counties of Middlesex and Northumberland and of all America, one of the Lords of his Majesty's most Honorable and Privy Council and Knight of the most noble Order of the Garter, etc., etc., etc."

We find further that he was not only all of this but more. That he was as efficient in matters of business as any modern real-estate executive is attested by the fact that in thirty years of management of Alnwick Castle, his ducal estate, the rent rolls were increased from £8,000 to £50,000, notwithstanding the fact that he lived meanwhile on an extravagant scale, planted twelve hundred trees, and invested large sums in draining and reclaiming parts of his land and in improving the living conditions of his workmen.

The elder Smithson showed equal ability in his public life. His stand in the matter of carrying on war with the American colonies is interesting in view of later developments. He vigorously opposed such action, and when his son, Lord Percy, half-brother of James Smithson, was ordered to America with the British Army, Sir Hugh exerted his power to obtain for Percy a leave of absence, of which, however, the latter refused to avail himself.

Lord Percy, like his father, had the feeling that the wrong policy was being pursued toward the American colonies, but his loyalty and military discipline overbalanced this feeling and he "carried on," as plainly indicated in the following letter to his father written in 1774 from Boston, where he was in command of the English camp:

"As I cannot say this is a business I very much admire, I hope it will not be my fate to be ordered up the country. Be that as it may, I am resolved cheerfully to do my duty as long as ever I continue in the service. If I do

not acquire any degree of reputation in it, it will be my misfortune, but shall never be my fault."

It is of keen interest to realize how closely this half-brother of James Smithson was connected with the preliminary events of our Revolution. In fact it was solely his valiant action that saved from utter destruction the English troops in their retreat from the expedition to Concord in April, 1775. This expedition gave rise to the battle of Lexington, known to every American schoolboy as the starting point of our struggle for liberty. Lord Percy's own connection with the affair is recalled by Lowell in these lines:

> Old Joe is gone who saw hot Percy goad
> His slow artillery up the Concord road.
>
> * * *
>
> Had Joe lived long enough, that scrambling fight
> Had squared more nearly with his sense of right,
> And vanquished Percy, to complete the tale,
> Had hammered stone for life in Concord jail.

As a matter of history, Percy never entered the Concord jail, nor could he be described as vanquished—quite the reverse, in fact, for he rescued the King's infantry from certain destruction and saw them safely back to Charlestown. And to us, with our vivid recollections of the endless columns of motorized artillery associated with modern warfare, his "slow artillery on the Concord road" falls short of impressiveness, for we know that it consisted of two cannon! To bring more reality to his exploit, let us read once more from his letters to his father back in Britain:

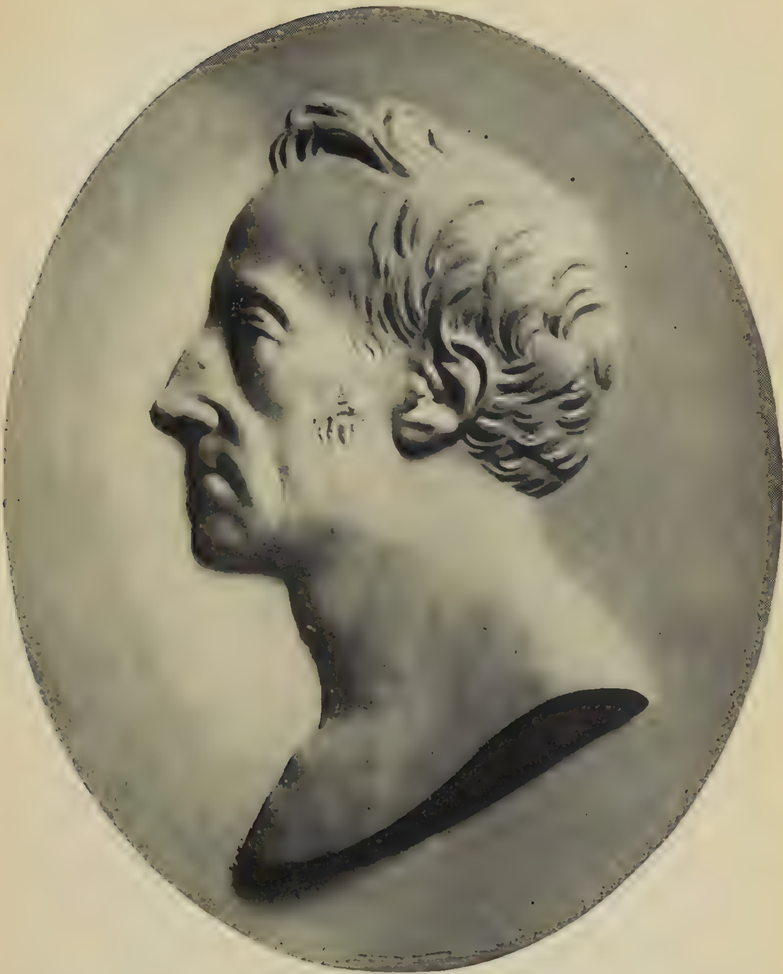
"I was ordered out yesterday morning to cover the retreat of the Grenadiers and Light Infantry who had been sent upon an expedition up the country. I had with me my brigade and two pieces of cannon. We met them at a town about fifteen miles off, sharply attacked and surrounded by the rebels, and having fired away all their ammunition. I had the happiness of saving them

from inevitable destruction, and arriving with them in Charlestown, opposite Boston, at eight o'clock last night; not, however, without the loss of a great many, having been under an incessant fire for fifteen miles. The rebels, however, suffered much more than the King's troops. I have not myself received even the least scratch, and I beg that you will not either of you be uneasy on my account."

In spite of the military exploits of his half-brother, Lord Percy, and the political eminence of his father, the Duke of Northumberland, Smithson's prophecy that his name would outlive theirs has been amply fulfilled in the world-wide recognition of the Smithsonian Institution. Smithson's studious and somewhat retiring personality was quite different from that of his father and half-brother. He was born in 1765, but there is no record of young Smithson's life until his entry in Pembroke College, Oxford, in 1782, under the name of James Lewis Macie, the name James Smithson not being adopted until fourteen years after his graduation. During his four years at this college, famous for its distinguished fellows, among them Blackstone and Dr. Samuel Johnson, Smithson developed that taste for scientific pursuits which deeply affected his whole life, and appeared in the remarkable provisions of his will. His studiousness, good scholarship, and industry attracted considerable attention. He graduated in 1786, and shortly after took lodgings in London, where he diligently pursued researches in his favorite science, chemistry.

Smithson developed remarkable ability in working with very small quantities of chemical substances, at one time conducting two hundred and fifty experiments with a few fragments, altogether making about half of a cubic inch in volume, of a substance known as tabasheer which occurs in bamboo cane. In connection with his skill in manipulating small quantities of material, it is said that he was fond of narrating an incident illustrating this faculty. On a certain occasion he happened to observe a

PLATE 75



Medallion of James Smithson, founder of the Smithsonian Institution

A

CHEMICAL ANALYSIS

OF SOME

CALAMINES.

BY

JAMES SMITHSON, ESQ. F. R. S.

FROM THE

PHILOSOPHICAL TRANSACTIONS.

LONDON:

PRINTED BY W. BULMER AND CO. CLEVELAND-ROW,
ST. JAMES'S.

1803.

Facsimile of the title-page of one of James Smithson's scientific publications

lady crying, and hastily taking out a small crystal vessel, he seized the opportunity to catch one of the teardrops in the hope of analyzing it, and although half of the precious drop escaped, he succeeded in detecting in the other half not only appreciable amounts of muriate of soda but also the compound of phosphorus known at that time as microcosmic salt, and certain other saline substances! Regarding the value of his minute researches, Smithson says, "there may be persons, who, measuring the importance of the subject by the magnitude of the object, will cast a supercilious look on this discussion; but the particle and the planet are subject to the same laws, and what is learned of one will be known of the other."

We must remember that at the period in which Smithson lived, chemistry was not considered an exact science, and in fact was but little removed from the alchemy and magic of a short time before. Chemical apparatus and instruments were primitive and undeveloped and the chemical reagents obtainable were crude and unsatisfactory. Yet notwithstanding these handicaps, young Smithson produced some very creditable analyses, and although his work was carried on before the atomic theory had been formulated by the great Dalton, nevertheless his writings show that he was well aware of some law of definite proportions in chemical relations. A perception of the vast scope of the science, which seems remarkable for that age, appears in the following statement which occurs in one of his papers: "Chemistry is yet so new a science, what we know of it bears so small a proportion to what we are ignorant of; our knowledge in every department of it is so incomplete, consisting so entirely of isolated points, thinly scattered, like lurid specks on a vast field of darkness, that no researches can be undertaken without producing some facts leading to consequences which extend beyond the boundaries of their immediate object."

After his graduation from Oxford, Smithson's keen

interest in scientific matters and his desire to be in close association with men of science led him to seek admission into the membership of the Royal Society of London, the meeting place of all the scientific intellects of England. Arago once said, "The Royal Society of London enjoys throughout the whole kingdom a vast and deserved consideration. . . . Here is always the highest point of ambition of the man of science." Smithson's application was considered, and in April, 1787, he was admitted to membership, less than one year after his graduation. The official recommendation, signed by some of the most prominent scientific men of the day, reads as follows:

"James Lewis Macie, Esq., M. A., late of Pembroke College, Oxford, and now of John Street, Golden Square —a gentleman well versed in various branches of Natural Philosophy, and particularly in Chymistry and mineralogy, being desirous of becoming a Fellow of the Royal Society, we whose names are hereto subscribed do, from our personal knowledge of his merit, judge him highly worthy of that honour and likely to become a very useful and valuable member.

(Signed) "Richard Kirwan
"C. F. Greville
"C. Blagden
"H. Cavendish
"David Pitcairn."

From this time on, James Smithson devoted his life to his scientific pursuits, traveling in the interests of his researches, and to writing. The purpose of his bequest to mankind "for the increase and diffusion of knowledge among men" is foreshadowed in his own life, for he had constantly in mind the effort to increase existing knowledge and apply it for the benefit of man. His extensive travels in Europe gave him a cosmopolitan character and caused him to realize that the pursuit of science cannot be confined within the borders of any one coun-

try, but must be world-wide in its contacts. He himself was born in England, lived most of his life in France and Germany, died and was buried in Italy, and entrusted his fortune and the perpetuation of his name to the United States of America.

Smithson's published scientific writings consist, so far as known, of twenty-seven papers appearing between 1791 and 1825 in the *Philosophical Transactions of the Royal Society of London*, and in Thomson's *Annals of Philosophy*. Of these twenty-seven, all relate to chemistry and mineralogy except two, in which Smithson diverges to show a practical turn, namely: "Some improvements of lamps," published in 1822, and "An improved method of making coffee," issued the following year. All of Smithson's writings exhibit a remarkable clarity of expression and a studied accuracy. Certain of his publications contain passages which show not only his excellent knowledge of his favorite subjects, but also give an insight into the breadth of his outlook and his wide learning. Note in the following passage from one of his papers his appreciation of the study of anthropology:

"More than commonly incurious must he be who would not find delight in stemming the streams of ages, returning to times long past, and beholding the then existing state of things and of men. In the arts of an ancient people much may be seen concerning them, the progress they had made in knowledge of various kinds, their habits, and their ideas on many subjects. And products of skill may likewise occur, either wholly unknown to us, or superior to those which now supply them."

In another paper he shows clearly in the following words his appreciation of a law of definite proportions, although, as stated above, Dalton had not as yet announced the atomic theory:

"It is evident that there must be a precise quantity in which the elements of compounds are united together in

them; otherwise a matter which was not a simple one would be liable, in its several masses, to vary from itself, according as one or other of its ingredients chanced to predominate. But chemical experiments are unavoidably attended with too many sources of fallacy for this precise quantity to be discovered by them; it is therefore to theory that we must owe the knowledge of it. For this purpose an hypothesis must be made and its justness tried by a strict comparison with facts. If they are found at variance, the assumed hypothesis must be relinquished with candor as erroneous; but should it, on the contrary prove, on a multitude of trials, invariably to accord with the results of observation, as nearly as our means of determination authorize us to expect, we are warranted in believing that the principle of nature is obtained, as we then have all the proofs of its being so which men can have of the justness of their theories: a constant and perfect agreement with the phenomena, as far as can be discovered."

Smithson's writings were well received by the contemporary men of science, and he himself was an intimate friend of Cavendish and Arago, and in close touch with most of the other learned men of that period. Through his researches he attained a high standing both in England and abroad.

As Smithson's life drew toward its close, we lose track of him except through occasional mention in the writings of others. His health had become very poor, and he spent most of his time in Paris and on the Riviera. His infirmities must have driven him to desperation, for we find the following account of a peculiar turn in his life in the writings of the renowned Arago:

"Some years since in Paris I made the acquaintance of a distinguished foreigner of great wealth, but in wretched health, whose life, save a few hours given to repose, was regularly divided between the most interesting scientific researches and gaming. It was a source of great regret

to me that this learned experimentalist should devote the half of so valuable a life to a course so little in harmony with an intellect whose wonderful powers called forth the admiration of the world around him. Unfortunately there occurred fluctuations of loss and gain, momentarily balancing each other, which led him to conclude that the advantages enjoyed by the bank were neither so assured nor considerable as to preclude his winning largely through a run of luck. The analytical formulas of probabilities offering a radical means, the only one perhaps of dissipating this illusion, I proposed, the number of the games and the stakes being given, to determine in advance, in my study, the amount, not merely of the loss of a day, nor that of a week, but of each quarter. The calculation was found so regularly to agree with the corresponding diminution of the banknotes in the foreigner's pocketbook that a doubt could no longer be entertained."

The best manner of glimpsing Smithson's reflections in looking back over a somewhat lonely, disappointing life, is to read his most important piece of writing—his will. This he prepared deliberately and in full possession of his faculties three years before his death. Having no family for whom to provide, he remembers first a faithful servant, and then wills his whole fortune to a nephew and to any possible heirs of this nephew. Then, almost as an afterthought, probably recalling his youthful ambitions to perpetuate his name in the minds of men, he enacts the most important deed of his life in providing for a learned institution to bear his name, in the event of the nephew's death without heirs. With this preamble, we present James Smithson's last will and testament, which in itself exemplifies his carefulness and attention to detail.

"The Will of James Smithson"

"I James Smithson Son of Hugh, first Duke of Northumberland, & Elizabeth, Heiress of the Hungerfords of

Studley, & Neice to Charles the proud Duke of Somerset, now residing in Bentinck Street, Cavendish Square, do this twenty-third day of October, one thousand eight hundred and twenty-six, make this my last Will and Testament:

"I bequeath the whole of my property of every nature & kind soever to my bankers, Messrs. Drummonds of Charing Cross, in trust, to be disposed of in the following manner, and I desire of my said Executors to put my property under the management of the Court of Chancery.

"To John Fitall, formerly my Servant, but now employed in the London Docks, and residing at No. 27, Jubilee Place, North Mile End, old town, in consideration of his attachment & fidelity to me, & the long & great care he has taken of my effects, & my having done but very little for him, I give and bequeath the Annuity or annual sum of One hundred pounds sterling for his life, to be paid to him quarterly, free of legacy duty & all other deductions, the first payment to be made to him at the expiration of three months after my death. I have at divers times lent sums of money to Henry Honore Sailly, formerly my Servant, but now keeping the Hungerford Hotel, in the rue Caumartin at Paris, & for which sums of money I have undated bills or bonds signed by him. Now, I will & direct that if he desires it, these sums of money be let remain in his hands at an Interest of five per cent. for five years after the date of the present Will.

"To Henry James Hungerford, my Nephew, heretofore called Henry James Dickinson, son to my late brother, Lieutenent-Colonel Henry Louis Dickinson, now residing with Mr. Auboin, at Bourg la Reine, near Paris, I give and bequeath for his life the whole of the income arising from my property of every nature & kind whatever, after the payment of the above Annuity, & after the death of John Fitall, that Annuity likewise, the payments to be made to him at the time of the interest or dividends

Tomb of James Smithson, transferred from Genoa to a special room near the main entrance of the Institution he founded

In the case of the death of my
said nephew without leaving a child or
children or of the death of the child or
children he may have had, under the age
of twentyone years, or intestate I then
bequeath the whole of my property,
subject to the annuity of one hundred
pounds to John Fitall, and for the
security and payment of which I mean
stock to remain in this country, to the
united states of america, to found at
Washington, under the name to the Smithsonian
institution, an establishment for the increase
& diffusion of Knowledge among men.

Facsimile of the part of James Smithson's will relating to the founding of the Smithsonian Institution

becomes due on the Stocks or other property from which the income arises.

"Should the said Henry James Hungerford have a child or children, legitimate or illegitimate, I leave to such child or children, his or their heirs, executors, & assigns, after the death of his, or her, or their Father, the whole of my property of every kind absolutely & forever, to be divided between them, if there is more than one, in the manner their father shall judge proper, or, in case of his omitting to decide this, as the Lord Chancellor shall judge proper.

"Should my said Nephew, Henry James Hungerford, marry, I empower him to make a jointure.

"In case of the death of my said Nephew without leaving a child or children, or the death of the child or children he may have had under the age of twenty-one years or intestate, I then bequeath the whole of my property subject to the Annuity of One hundred pounds to John Fitall, & for the security & payment of which I mean Stock to remain in this Country, to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an Establishment for the increase & diffusion of knowledge among men.

"I think it proper here to state, that all the money which will be standing in the French five per cents. at my death in the names of the father of my above mentioned Nephew, Henry James Hungerford, & all that in my name is the property of my said Nephew, being what he inherited from his father, or what I have laid up for him from the savings upon his income.

(Signed) "JAMES SMITHSON. [L. S.]"

Smithson died on June 27, 1829, at Genoa, Italy, and was buried in the Protestant cemetery near Genoa, on a hill overlooking the harbor. The estate passed to his nephew, Henry James Hungerford, at that time twenty-three years of age, who lived to enjoy it for only about six

years, when he died unmarried and without heirs. The claim of the United States to the property was thus clear, but to bequeath a legacy to a foreign nation for a specified purpose did not prove to be so simple a matter. In the next chapter we will follow the vicissitudes of what was in those days a very large fortune.

In concluding our examination of this remarkable bequest, let us speculate briefly on Smithson's reasons for leaving his estate to America. No reference is made in his published writings to that country, and so far as known he had no friends or correspondents there. The most likely reason for his action is given in a statement by William J. Rhees, who as chief clerk, keeper of the archives, and distributor of publications, served the Smithsonian Institution for many years:

"It is more probable that, living at a time when all Europe was convulsed with war, when the energies of nations, the thoughts of rulers, and the lives of millions were devoted to efforts for conquest or to perpetuate despotism, he turned to the free American Republic, where he could discern the germs of rising grandeur, the elements of enduring prosperity, and the aspirations of coming generations. He undoubtedly felt that in the United States there would be wider scope for the promotion of knowledge, and that in this new country there would always be free thought and indefinite progress."

This, then, is the picture. James Smithson, a man denied, by the unfortunate circumstances of his birth, the name, titles, and position which he felt should have been his, determined in the zeal of his youthful ambition to make his name outlive that of his illustrious father through the scientific researches which he loved. Through middle life he pursued his quest of knowledge, creating new truths and publishing them for the benefit of his fellow men. His work was excellent and formed a real contribution to the advancement of science, but as the autumn of life drew on he began to realize somewhat

sadly, we seem to feel, that it was not enough to carry his name down through the ages. Without close relatives, he provided in his last will and testament, first for an old servant; then for a nephew and any possible heir of his; and finally, as it appears, as a last resort in his life-long desire to have his name live in the memory of man, for an institution bearing his name, for the increase and diffusion of knowledge among men. Such an institution would carry out for him the twofold purpose of perpetuating his name and carrying on the work which he loved—the enlargement of the domain of knowledge.

If James Smithson were permitted today to examine the results of his benefaction, no doubt he would find them exceeding his fondest expectations. His name, embodied in the name of the Smithsonian is known and honored throughout the civilized world, and will long remain so. Through its many years of faithful endeavor to carry out Smithson's injunction to increase and diffuse knowledge, many of his "lurid specks on a vast field of darkness" have developed into brilliant patches of light against a diminishing black background.

CHAPTER XIV

RICHARD RUSH AND THE GOLD

"A chancery suit is a thing that might begin with a man's life and its termination be his epitaph."

In September, 1835, a London dispatch surprised the Secretary of State, the Honorable John Forsyth. It came from the *chargé d'affaires* of the United States at London, forwarding a letter from a firm of London attorneys. The letter enclosed a copy of the will of James Smithson and stated that the nephew mentioned by Smithson in his will had died, thus making the United States entitled to the £100,000 estate. President Jackson presented these facts to Congress in December of the same year, and from this time forward events moved on, though somewhat jerkily at times, toward the culmination of James Smithson's dream of an institution bearing his name to be conducted for the benefit of mankind.

The matter was immediately taken up by Congress, and after several months of discussion, not without some warmth on both sides, a bill was passed directing the President to appoint an agent to prosecute the claim of the United States in the English Court of Chancery.

Ex-President John Quincy Adams reported the bill in the House, and the Committee's report gave a glowing appreciation of Smithson's altruistic bequest. After rehearsing the glorious history of his ancestors and relatives of the families of the Percys and the Seymours, the report said of the testator's purpose:

"Should it be faithfully carried into effect, with an earnestness and sagacity of application, and a steady perseverance of pursuit, proportioned to the means furnished by the will of the founder, and to the greatness and simplicity of his design as by himself declared, 'the increase and diffusion of knowledge among men,' it is no extravagance of anticipation to declare that his name will be hereafter enrolled among the eminent benefactors of mankind. . . . Let the result accomplish his object . . . and a wreath of more unfading verdure shall entwine itself in the lapse of future ages around the name of Smithson than the united hands of tradition, history, and poetry have braided around the name of Percy through the long perspective in ages past of a thousand years."

In the Senate, Mr. Preston, of South Carolina, remarked that "the genealogy of Mr. Smithson was given and traced through the line of the illustrious Percys and Seymours of England. There was danger of Senators' imaginations being run away with by associations of Chevy Chase ballads. He thought this donation had been partly made with a view to immortalize the donor, and that it was too cheap a way of conferring immortality." Senator Calhoun, of South Carolina, thought it "beneath the dignity of the United States to receive presents of this kind from anyone." Nevertheless the Senate voted 31 to 7 to prosecute the claim.

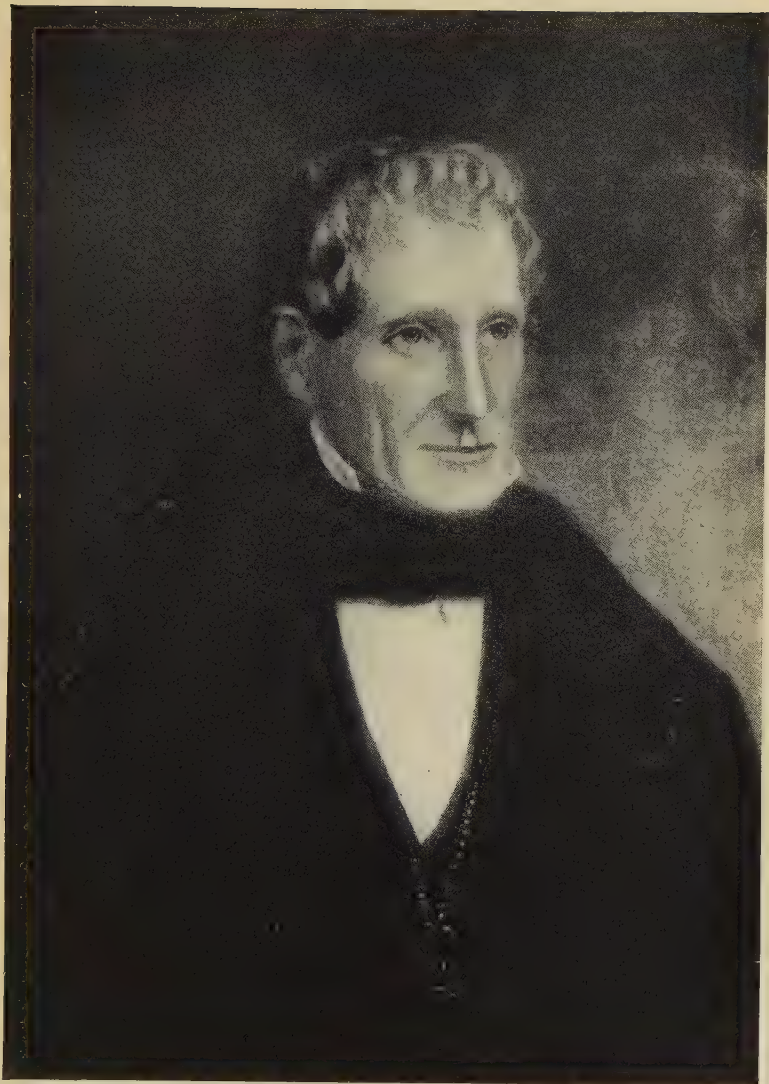
In casting about for the right person to prosecute the claim, one name naturally presented itself—one who had held the positions of Comptroller of the Treasury and Secretary of the Treasury, giving him ample experience in financial matters; who for eight years had served as United States Minister to England, acquainting him with English ways. This man was Richard Rush of Pennsylvania. His father, Dr. Benjamin Rush, was a distinguished figure during the period of the American Revolution, having been a member of the Continental Con-

gress, a signer of the Declaration of Independence, and the first Surgeon General of the American Army. An interesting sidelight on the feeling regarding public office at that time is given in a passage from the writings of Doctor Rush:

"November 23, 1811.

"This day it was announced in the *National Intelligencer* that my son Richard Rush was appointed Comptroller of the United States, and to my great astonishment and distress on November 25th he set off for Washington to accept of it. I dissuaded him from doing so from the following considerations: *First.* The degradation to which such an office exposed a man of literary and professional talents. It was an office that could be filled by any clerk of a bank. *Second.* The vexations and poverty of political life. *Third.* His comfortable establishment and excellent prospects in Pennsylvania, the State of his ancestors and family. *Fourth.* The sickliness of Washington and the insufficiency of the salary to support a growing family. *Fifth.* The dishonor which he would do to his understanding by such an act. *Sixth.* My age, also my young family, which required his advice now and would still more require it after my death. I offered to implore him not to accept of the appointment upon my knees, but all, all to no purpose. Oh, my son, my son Richard, may you never be made to feel in the unkindness of a son the misery you have inflicted upon me by this rash conduct. He was dissuaded from it by all his friends and was blamed for it by most of the citizens of Philadelphia who knew him."

However, Doctor Rush's uneasiness for his son's future proved to be unfounded, as shown by his distinguished record mentioned before. "To these great and varied employments," wrote the Honorable J. A. Pearce, "he brought integrity, ability, intelligence, firmness, courtesy, and a directness of purpose which scorned all finesse and



Richard Rush, who put the claim of the United States to Smithson's estate through the English Court of Chancery, and brought back the legacy in gold sovereigns

which served his country to the full extent of all that could have been demanded or hoped."

On July 11, 1836, the Secretary of State, John Forsyth, notified Mr. Rush of his appointment by the President to prosecute the claim of the United States to the Smithson estate. He was to receive as compensation $3,000 a year, with $2,000 allowance for all contingencies other than legal expenses. In startling contrast to this relatively small salary, he was required to furnish bond in the amount of $500,000, approximately the sum represented by the Smithson bequest.

After providing a satisfactory bond, Mr. Rush boarded the next ship for England, arriving at Liverpool on August 31. Soon after reaching London, he employed as his solicitors the legal firm of Clarke, Fynmore, and Fladgate, who had first notified the United States of its claim to the estate. Before he had received legal advice on the matter, Mr. Rush hoped that it might be possible, in order to avoid the delays and annoyances attendant on a lawsuit, to have the American Minister bring the matter directly to the attention of the British Government. However, it turned out to be necessary to file a bill in the name of the President of the United States against Smithson's executors, stating that the United States was entitled to the estate. Here Mr. Rush was brought face to face with a discouraging situation—he found that it was necessary to sue in the Court of Chancery.

A few words about the English Court of Chancery at that time will show us what Mr. Rush must have felt on learning this news. In 1853, Dickens wrote that there was then "a suit before the Court of Chancery which had been commenced twenty years before, in which from thirty to forty counsel had been known to appear at one time, in which costs had been incurred to the amount of £70,000, which was a *friendly* suit, and which was no nearer its termination than when it was begun." The Court of

Chancery considered matters relating to both common law and equity. Often it was called upon to give relief when a suit had been settled legally but obviously unjustly in a common-law court. Furthermore it was sometimes doubtful which court had jurisdiction, so that occasionally after a long and expensive suit, the suitor found that he had gone to the wrong court and must make a fresh start in the other branch. These conditions justified Lord Westbury's statement that "one tribunal was set up to do injustice and another to stop it."

However, in the face of this discouraging outlook, Richard Rush entered vigorously upon his duty, that of securing the Smithson estate for the United States. Let us follow him briefly through the intricacies and formalities of a chancery suit. He had arrived in England late in August, 1836, yet as late as December 20 of that year, his letter to the Secretary of State, to whom he transmitted most of the official reports of his activities, states that while the Smithson case continued favorably, it had not yet had its first actual hearing before the Court of Chancery. The next month, the first hearing still not having been held, he must have been slightly discouraged, for he writes, "We must hope that the bequest of Mr. Smithson will ultimately be adjudged to the United States"; that there is a complication in the matter, "and we dare not with confidence affirm that the decision will be favorable prior to its taking place."

However, in February, 1837, the case was formally opened before Lord Langdale, Master of the Rolls. Mr. Pemberton, of Pemberton and Jacob, employed as counsel by Mr. Rush in addition to the solicitors mentioned before, appeared on behalf of the United States, and the King's counsel at once announced the abandonment of all opposition from the Crown, with the result that the case was referred to one of the masters in chancery, Mr. Nassau William, Sr. He was to make the inquiries necessary in order to verify the validity of the United

States' claim on the legacy, and also to examine the claim of Madame de la Batut, the mother of Henry James Hungerford, Smithson's nephew.

Madame de la Batut stated that her son had provided her with a generous income during his life, and that according to the will of his father, Colonel Dickinson, half of the income from the Colonel's property, which he had bequeathed to his brother, James Smithson, was to be paid to her during her lifetime. It appears that young Hungerford had spent his life and all of the income from Smithson's estate roving about Europe, and at his death there was left not enough to even pay debts or funeral expenses. A somewhat peculiar "moral claim" was also entered by Madame de la Batut, urging that the purpose of the Smithson bequest, "for the increase and diffusion of knowledge among men," required that knowledge first be increased and diffused among her children by providing for their education until they were twenty-two years of age. In short, she claimed an annuity of £240, and in order to expedite matters, Mr. Rush agreed to a compromise allowing her £150 a year during her lifetime.

To return to the Chancery Court, it was then ordered that advertisements be inserted in English, French, and Italian newspapers, requesting information as to whether Henry James Hungerford had married, whether he had left children, etc. Mr. Rush saw to it that these advertisements were made as brief as possible consistent with the court order, so that there would not spring up a crop of false claimants, who could do no harm to the cause of the United States but who might greatly delay the proceedings.

In April, 1837, Mr. Rush writes that he is carefully watching the legal expenses which, he had been warned, were very heavy in a suit in chancery. His letter further states: "It seems that something is to be paid for every step taken, every line written, and almost every word

spoken by counsel, senior and junior, solicitors, clerks, and everybody connected with the courts, and officers attached to them."

Apparently affairs then began to drag, for in August, 1837, the Secretary of State received from Mr. Rush a letter saying that the Chancery Court was at that time more than 800 cases in arrears, and that he was becoming much discouraged regarding the prospects of an early settlement of the suit. He stated further that "while the population of England has increased in a definite period sixfold and her wealth twentyfold, the judicial establishment has remained nearly the same. There are only eleven masters in chancery, while double the number would not be sufficient. The subject of a reform in this court, Mr. Rush stated, had been specially recommended by the Throne to Parliament." This helpless feeling expressed by Mr. Rush reminds us that the term, "in chancery," is used in boxing to indicate the action of one boxer in getting the head of the other securely under his arm so that he can pound it without fear of retaliation, the allusion being to the helplessness of a person involved in a chancery suit, which was certain to mean heavy cost and loss.

In February of the following year, Mr. Rush's letters again begin to sound more hopeful, for in that month he writes to his solicitors that he is willing to have the master's report made without taking any further evidence, with the hope that an appeal to the House of Lords might thereby be avoided. In March, he writes that the master's report has been submitted and confirmed, and that he hopes to have a decree following the Easter term. Affairs rapidly drew to a climax, and on May 12, 1838, less than two years after the suit was entered, he writes triumphantly to the Secretary of State:

"I have great satisfaction in announcing to you, for the President's information, that the case came on to be heard again on the 9th instant, when a decree was sol-

emnly pronounced adjudging the Smithson bequest to the United States."

Mr. Rush's enthusiasm and keen interest in the matter, which probably had more to do with the comparatively speedy outcome than any other one thing, is evidenced by his further statement that "a suit of higher interest and dignity has rarely perhaps been before the tribunals of a nation. If the trust created by the testator's will be successfully carried into effect by the enlightened legislation of Congress, benefits may flow to the United States and to the human family not easy to be estimated, because operating silently and gradually throughout time, yet operating not the less effectually."

An amusing incident occurred in England immediately following the court decree and the publication in the daily papers of the circumstances of the award and the amount of the bequest. Two claimants for Smithson's estate appeared in London almost simultaneously, although they had no connection or relationship with each other. These two gentlemen appeared surprised on learning that the case was closed and were quite urgent in their requests that it be reopened. However, upon being assured positively that they were too late, they quickly dropped out of sight and were heard from no more.

The culmination of this important suit in less than two years is to be regarded as one of the most remarkable events connected with the Smithson bequest. Such a relatively prompt termination of a difficult suit in the face of an almost hopeless situation is little short of miraculous, and all credit is due Richard Rush. The general surprise and approbation at the speedy outcome was expressed jointly by the American Minister to England and the Consul at London in these strong words:

"No litigant ever displayed a more ardent zeal or a more sagacious, devoted, and unremitting diligence in the prosecution of his private suit than *he* did in urging on

this public one to a prompt and successful conclusion. The dispatch with which in consequence his purpose was finally accomplished is almost without example in the annals of chancery. His solicitors will long remember his adroit and unsparing application of the spur. Had he not urged them to the top of their speed, he would have had a lighter weight of gold to carry home with him."

But to be fair to his solicitors, we must also read what Mr. Rush himself wrote about them:

"More attention, diligence, discretion, and integrity could not have been exerted by any persons than they have shown throughout the whole suit from first to last. Could they ever have forgotten what was due to the United States and to themselves, in the desire to eke out a job, nothing is plainer to me, from what has been passing under my observation of the entanglements and delays natural to a heavy suit in the English Court of Chancery, than that they might have found opportunities in abundance of making the suit last for years yet to come."

Early in June the entire estate, principally in three per cent annuities, was actually turned over to Mr. Rush, and he immediately busied himself with plans to convert it into cash. He secured the assistance of Colonel Aspinwall, U. S. Consul General at London, who through his knowledge and experience regarding the great London stock exchange, would be able to obtain the best possible prices for any securities sold. Fortune seemed to smile on the activities of Mr. Rush, for when the consols and Bank of England stock were sold, they brought a higher price than had been paid for them for many years previously, or for that matter than was paid for a long time afterwards. The consols brought 95⅜, certain other three-per cent annuities 94, and the Bank of England stock 205, yielding a total of over £100,000.

Mr. Rush next took up the problem of how to transfer the money to America. After considering several plans,

he finally decided to convert the entire amount into gold sovereigns, as this seemed not only to be the safest way, but in saving the cost of exchange added over a thousand pounds to the Smithson fund. Through the continued assistance of Colonel Aspinwall, Mr. Rush arranged for the transportation of this gold on the packet *Mediator*, Captain Champlain commanding, which was to set sail for New York on July 17, 1838. The costs of the whole affair, amounting to something over £2,400, were settled by Mr. Rush, marine insurance was arranged for, and all other details were cleared up, and on the appointed day he boarded the *Mediator*, with the bags of gold stowed safely in her hold.

At sea the *Mediator* encountered squalls, gales, and head winds, making things very uncomfortable at times, but although considerable time was lost, the ship came through with flying colors, and sailed into New York Harbor on August 29, 1838. Mr. Rush, on landing, found awaiting him instructions from the Secretary of the Treasury to transfer the Smithson fund to the mint at Philadelphia. A letter was also handed him from the Secretary of State, who offered his congratulations on the successful outcome of the matter. On September 1, Mr. Rush took the stage for Philadelphia, taking with him the one hundred and five bags of gold sovereigns. On the same day he turned them over formally to the Director of the Mint and received from him a receipt for $508,318.46, the amount found to be equivalent to the English money. Mr. Rush records with great exactness that he turned over to the mint the one hundred and five bags of sovereigns, eight shillings and sixpence. This extreme minuteness is something amusing, for in another report he states that he received from the Bank of England, in addition to the bags of sovereigns, eight shillings and sevenpence. This discrepancy, it seems, did not, however, receive official cognizance, for Congress and the accounting officers subsequently approved all of Mr.

Rush's expenditures and accounts, and he was fully discharged from his trust.

With the Smithson fund, Mr. Rush also brought from England three boxes of James Smithson's personal effects. These remained in the custom-house at New York for three years, until at the urgent request of the National Institute of Washington, they were sent on to that city. Here they were examined and found to contain, in addition to clothing and household articles, a cabinet of minerals, a collection of books and pamphlets, and a large amount of manuscript in Smithson's handwriting. The minerals proved to be quite rare and valuable, and were thus reported upon by the National Institute:

"A cabinet, consisting of a choice and beautiful collection of minerals, comprising probably eight or ten thousand specimens. These, though generally small, are exceedingly perfect, and constitute a very complete geological and mineralogical series, embracing the finest varieties of crystallization, rendered more valuable by accompanying figures and descriptions by Mr. Smithson, and in his own handwriting. The cabinet also contains a valuable suite of meteoric stones, which appear to be specimens of most of the meteorites which had fallen in Europe during several centuries."

Mr. Francis Markoe, a mineralogist of the time, wrote that it was "a superb collection, and very large, of precious stones and exquisite crystallized minerals, forming, as far as I can judge, decidedly the richest and rarest collection in this country."

The minerals and Smithson's books and unpublished manuscripts were later transferred to the Smithsonian building, where unfortunately they were nearly all destroyed in the disastrous fire of 1865. There still remain some books and letters as mementos of him. His remains and monument were transferred from Genoa to the Smithsonian in the year 1904.

We will now shift the scene to the floor of the House

and of the Senate at Washington, where out of the welter of debate, discussion, and propaganda, there took shape gradually the present Smithsonian Institution, with such a wise plan of organization that it has not been found necessary to the present day to adopt any material change in it.

CHAPTER XV

HOW CONGRESS ESTABLISHED THE SMITHSONIAN

NEARLY eight years passed from the time when America received Smithson's gold before Congress passed the Act which established the Smithsonian Institution.

In 1838 the matter of the Smithson bequest was referred in the House of Representatives to a committee of nine, with the Honorable John Quincy Adams, ex-President of the United States, as chairman, which received and considered plans for its disposition. One of these early plans was for a large agricultural school and farm, others provided "for the instruction of females," for "courses of lectures," a "school for the blind," and even for "improved methods of rearing sheep, horses, and silkworms." There soon developed serious opposition, particularly on the part of the chairman, Mr. Adams, to the use of any part of the fund for school or university purposes. He declared that he would rather see the Smithson money thrown into the Potomac than to see it devoted to the education of the youth of America. The scheme which he himself favored was the establishment of an astronomical observatory "to be superior to any other devoted to the same science in any part of the world." This scheme he pushed ardently and persistently throughout the ensuing years of discussion, in fact until the Government did provide for the interests of astronomy in the U. S. Naval Observatory.

Mr. Adams's vigorous efforts to insure the use of the Smithson fund in founding a great observatory were ex-

ceeded only by his fears that the money might be wasted or dissipated through ineffectual application. In his diary he writes on October 26, 1839:

"My mind is filled with anxiety and apprehension lest the fund should be squandered upon cormorants or wasted in electioneering bribery. . . . It is hard to toil through life for a great purpose with a conviction that it will be in vain, but possibly seed now sown may bring forth some good fruit hereafter. If I cannot prevent the disgrace of the country by the failure of the testator's intention, I can leave a record of what I have done and what I would have done to accomplish the great design if executed well."

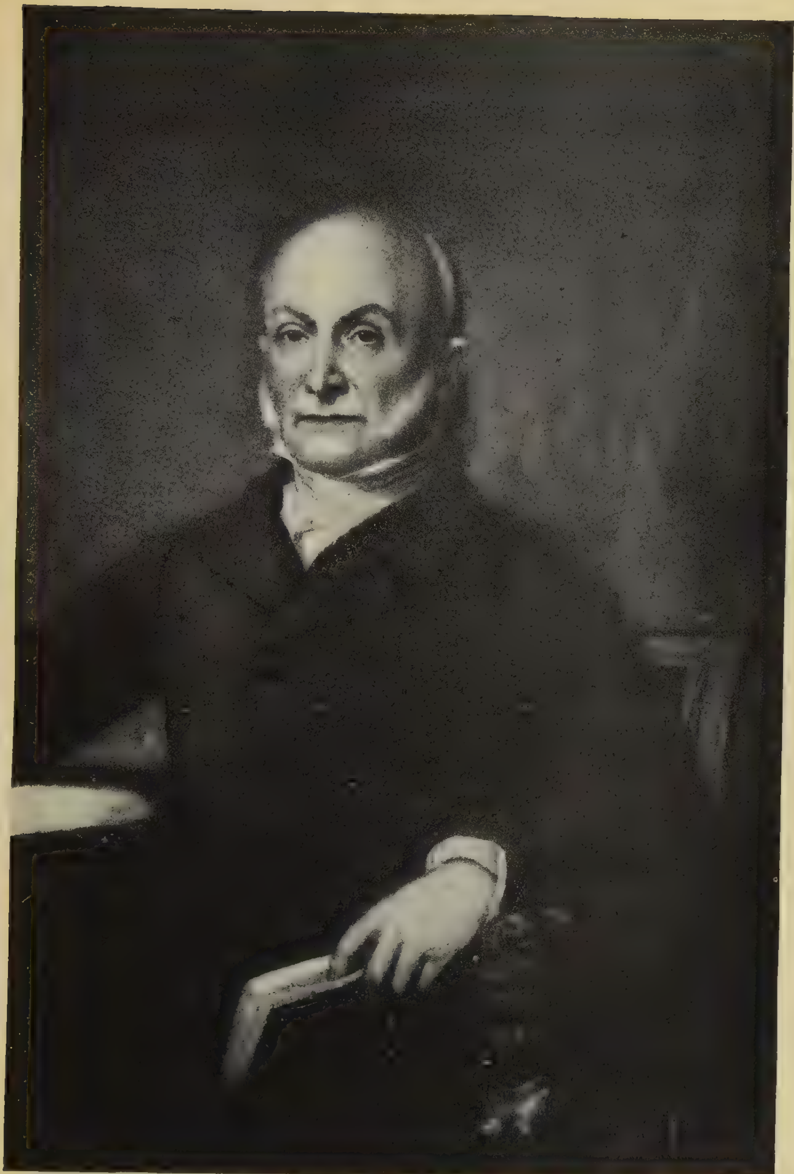
Mr. Adams's fears became later almost an obsession, and he looked upon all those who opposed his scheme for an observatory as attempting to pervert the money for some unlawful ends. His part in the work of establishing the Smithsonian lay rather in preventing Congress from entering into too hastily considered schemes than in developing the finally adopted plans himself. He was, however, probably the most influential in combating those who wished not to accept the bequest at all, and his greatest contribution lay in insisting that only the income from the fund should be used, and that the fund itself should be invested, not in State bonds as was done at first, but in the Treasury of the United States.

Richard Rush, whose noteworthy efforts in securing the Smithson fund itself we have already recounted, was among the earliest to offer suggestions for its application. Of these early schemes, his approached most nearly to the one finally adopted. He seems to have visioned with remarkable prescience, though in a somewhat ill-defined manner, the wisest development for the new Institution. His plan contained provision for lectures; for cooperation and correspondence with other scientific organizations; for receiving and exhibiting collections in all the major branches of science, including zoology, botany, geology,

ethnology, and the technical sciences; and for publishing the lectures and descriptions of the collections and other scientific material, for wide distribution. One of the most valuable suggestions contained in his proposal and one which was later put into effect, was that of requesting officials of the United States, such as consular officials and officers of the Army and Navy, to collect and send back to the Smithsonian specimens and information from frontiers and foreign lands.

In the Senate, the first feeling was that Smithson had in mind the establishing of a great university. The leading spirit in the support of this idea was the venerable Senator Asher Robbins, of Rhode Island, who outdid even his own previous record as a silver-tongued orator in his earnestness in this instance. He seems to have felt that all America needed to raise it to the level of the celebrated Athenian civilization in art and letters was a unique center of higher education such as he proposed to establish with the Smithson fund. In one of his speeches, after passing in review the glories of ancient Greece, he continues:

"Neither is the gift of genius wanting here; the gleams of this precious ore are seen to break out here and there all over the surface of our society; the *animus acer et sublimis* is daily displayed by our countrymen in all the forms of daring and enterprise; the eagle, their emblem, is not more daring in his flights. And if the love of fame, which was the ruling passion of the Greek, is not now so strong with us, it is because the want of the means, the want of plain and sure directions for its pursuit, begets a despair of its attainment. The Greek had these means, had these plain and sure directions; and it was the certainty of success by perseverance and by their guide that kindled and sustained his passion, and made it his ruling passion. This passion is now burning in the young bosoms of thousands of our youth; but it is, as I have said, *vis consili expers*, and struggles in vain because



John Quincy Adams, sixth President of the United States, who as a member of the House of Representatives, took a leading part in the debates on what the Institution should be

Joel Poinsett, 1779-1851, American statesman and President of the National Institute, which furnished a helpful model on which to organize the Smithsonian

it struggles blindly for the fame it pants after. Let this Athenian mode of education be adopted in this instance —let it produce but a few examples of eminent success, (as I have no doubt it speedily would)—and thousands would rush to the path that had led to that success; and members now of this body are yet young enough to live to see a new era arising in our land—another golden age of literature, no less splendid than any that had gone before it—not excepting even the Athenian."

But Senator Robbins's dream of a "golden age of literature" was doomed not to be ushered in through the agency of the Smithson bequest, for his bill embodying the superuniversity idea was promptly laid on the table. His public life came to a close with the adjournment of the Twenty-fifth Congress, and with him went out the university plan.

At this time the most diversified schemes began to be proposed. Mr. Hassler, then at the head of the Coast and Geodetic Survey, proposed an astronomical school; a meteorological office was suggested, to receive observations from all parts of the country; and several schemes were presented for employing the fund in the promotion of agriculture. Public interest was aroused through the warm debates in Congress; letters poured in upon those who had interested themselves in the matter; the press took up the subject and carried many news items and editorials; in short, the whole country was showing a keen interest in the proper application of Smithson's gift to the Nation. The citizens of Washington, where the Institution was to be situated, addressed a communication to Congress, expressing "great anxiety to see the instructions of Smithson carried into effect, believing it impossible to calculate the good which an institution properly founded is susceptible of promoting in the improvement of the intellect, taste, and morals of the country."

In the midst of the discussions during the next Congress,

the Twenty-seventh, there was incorporated in Washington the National Institution, for the promotion of science and the useful arts, which played such a conspicuous part in the foundation of the Smithsonian that mention must be made of it. Its plan of organization was comprehensive and well thought out, and resembled in many particulars the final plan for the Smithsonian. In fact, its chief influence on the Smithsonian was shown in the addition to that Institution of a museum and other features which otherwise would probably not have been included in it.

The officers of the National Institution included many prominent Government officials. Through its excellent standing, it received many accessions of books and objects for its museum, and its membership increased rapidly. From the beginning, the idea was openly expressed that the National Institution should take over the administration of the Smithson fund. A number of its members were influential members of Congress, and they introduced bills and sought on every occasion to place the Smithson bequest under the control of the National Institution.

The leading figure in all of the affairs of the National Institution was Joel R. Poinsett, at that time Secretary of the Navy. He was its president from the date of its founding in 1840 until its sudden decline in 1845. He had a number of conferences with John Quincy Adams, and finally disclosed his plan to entrust the Smithson fund to this Institution. The climax came, however, in April, 1844, when all of the existing scientific organizations of note met in Washington. The National Institute, as it was then named, came in for its share of the glory of the occasion, and it was highly praised by several distinguished speakers. One of these was John Quincy Adams himself, who closed his address thus:

"I believe it eminently deserving of the fostering care and liberal patronage of the Congress of the United

States, and could anticipate no happier close to my public life than to contribute, by my voice and by my vote, to record the sanction of the nation's munificence to sustain the National Institute devoted to the cause of science."

It was hoped that after this very successful occasion, Congress might catch the spirit of enthusiasm for the Institute and perhaps see its way clear to entrust to it the administration of the Smithson fund. Even President Tyler in his opening address at the meetings expressed the opinion that this solution might be desirable, in the following words:

"Where can the Government find a safer depository for the fruits of its expeditions, fitted out to explore distant and unknown regions, than the National Institution? What can it better do for the 'increase and diffusion of knowledge among men' than by patronizing and sustaining this magnificent undertaking?"

However, in spite of its powerful supporters and rosy prospects, the National Institute was fated to come to an untimely end. The next Congress came and went without making any provision for it and without any suggestion of a connection with the Smithson fund. After this failure of its great effort of 1844, President Poinsett declined to be reelected, meetings were suspended, publication stopped, and although several futile efforts were made later to revive it, the National Institute as a power in the scientific world died in 1845. Its influence lived, however, in the Smithsonian Institution, organized shortly after. Had the National Institute not succeeded in putting before Congress and the people of the country the vision of a broad scientific establishment of unrestricted scope, it is probable that the Smithsonian would have been an astronomical observatory, a university for higher education, or some other of the thousand and one less catholic schemes proposed for it.

The National Institute being now definitely out of the

picture, the Twenty-eighth Congress again devoted its attention to a plan for the Smithsonian. Mr. Adams brought up again his favorite bill for an astronomical observatory, but as formerly it was not acted upon. In the Senate, a bill was reported by Mr. Tappan from the Committee on the Library, which after considerable modification, began to resemble the final plan; although it still contained provisions for lecturers and teachers, for a school of agriculture, and other features, which were later stricken out. This bill actually passed the Senate, but was not voted on in the House. During the discussion on Mr. Tappan's bill, a brilliant speech was delivered by the Honorable Rufus Choate, which attracted wide attention as a gem of Congressional oratory. In prefacing his remarks, Mr. Choate said, "Our sense of duty to the dead, the living, and the unborn who shall live; our justice, our patriotism, our policy, common honesty, common decorum, urge us, are enough to urge us, to go on without the delay of an hour, to appropriate the bounty according to the form of the gift." He opposed any form of school or university as being wholly unnecessary and injurious to those already in existence. His own preference was for a library, "one which for variety, extent and wealth should be equal to any in the world." In his eloquent support of this project, he said:

"The trust directs us to increase and diffuse knowledge among men. And do not the judgments of all the wise; does not the experience of all enlightened states; does not the whole history of civilization concur to declare that a various and ample library is one of the surest, most constant, most permanent, and most economical instrumentalities to increase and diffuse knowledge? There it would be, durable as liberty, durable as the Union; a vast storehouse, a vast treasury of all the facts which make up the history of man and of nature, so far as that history has been written; of all the truths which the inquiries and experiences of all the races and ages have

found out; of all the opinions that have been promulgated; of all the emotions, images, sentiments, examples, of all the richest and most instructive literatures; the whole past speaking to the present and the future—a silent, yet wise and eloquent teacher."

With the opening of the Twenty-ninth Congress, the one which finally took decisive action, Mr. Owen presented to the House his bill to establish the Smithsonian. This embodied the features of the bill offered at the last session by Mr. Tappan, with the addition of provisions for a normal school, for a library, for research and experiment by the professors, and for the publication of essays, pamphlets, and other works. In his earnest and able support of this bill, Mr. Owen deprecated the tardiness of Congress in carrying out the provisions of a generous bequest to the American people which it had solemnly accepted eight years before.

"Small encouragement is there," he said, "in such tardiness as this, to others, as wealthy and as liberal as Smithson and Girard, to follow their noble example! Small encouragement to such men to entrust to our care bequests for human improvement! Due diligence is one of the duties of a faithful trustee. Has Congress, in its conduct of this sacred trusteeship, used due diligence? Have its members realized, in the depths of their hearts, its duties and their urgent importance? Or has not the language of our legislative action rather been but this: 'The Smithsonian Fund! Ah, true! That's well thought of. One forgets these small matters.' "

Mr. George Rathbun of New York felt even more strongly regarding the great delay in the matter and stated in a strong speech that he would vote for any scheme which seemed plausible. He favored the appropriating of the Smithson fund faithfully and honestly for some sound project, but above all, he favored appropriating the money for some purpose whether it should at first prove to be good or bad. He desired to remove the

stain from the character of the United States Government incurred through the great delay in providing a means for carrying out the testator's wishes.

In the discussion of this bill, Representative G. W. Jones, of Tennessee, came out bitterly against the Smithsonian in any form, as he had on numerous previous occasions. He thought that the whole matter was wrong; that the Government had no right to accept the trust in the first place; and he proposed that the whole fund, in whatever form it might be, whether money or State bonds, should be returned to any of the heirs-at-law or next of kin of Mr. Smithson. He declared that "it was neither the right, the power, nor the true policy of the Government to attempt to rear upon the city of Washington an institution for the education of school teachers, agricultural professors, etc., to send out into the country. Every measure of this kind had the tendency to make the people throughout the country look more to this great central power than to the State governments."

Representative Stanton, also of Tennessee, brilliantly supported the Owen bill as it then stood, concluding with this remarkably prophetic statement:

"By proper management this Institution may doubtless be made the instrument of immense good to the whole country. To the Government it will be of no slight advantage. It will be a great institution. It may attain a character as high as that of the French Academy, and its authority will then be decisive in reference to numerous questions of a scientific nature continually presented to the committees of Congress and the departments of Government for determination and consequent action. Such an institution is greatly needed in the Federal City."

The discussions on this bill filled many pages of the Congressional proceedings; some of them showed remarkably broad vision, others quite the reverse. Some of the opponents of the bill grew quite bitter and caustic in their opposition, Representative Finklin, of Illinois, stat-

ing that he "regarded Mr. Owen's bill as one of the most odious and abominable ever presented, and he would rather see this half million returned to the British Court of Chancery, or ten millions sunk to the bottom of the Potomac, than to have this bill pass." Representative Andrew Johnson, later President, also attacked the bill, the record of his remarks reading:

"There was something a little farcical and amusing to him in this system of normal instruction, which was to provide the country with school teachers. He would like to see a young man, educated at the Smithsonian Institution and brought up in all the extravagance, folly, aristocracy, and corruption of Washington, go out into the country to teach the little boys and girls to read and write! These young men, so educated, would steal, or play the little pettifogger, sooner than become teachers. Ninety-nine out of a hundred of those who received the benefit of this Institution would hang about a law-office, get a license, become a pack of drones instead of schoolmasters. Washington City was not a place for such an institution. He believed that it would result in an injury to the country instead of a benefit."

After several days of protracted debate, the Owen bill finally came to a vote. The normal-school section was first voted out, then the section providing for lectures, and finally those relating to experiment and research in agriculture, manufactures, etc., publication of books and pamphlets, and prizes for certain essays, and just before the bill came to a vote, a substitute was offered by Representative William J. Hough, of New York, which retained most of the items agreed upon and omitted all the features stricken out of the Owen bill. This substitute bill passed the House by the close margin of 85 to 76. The bill then went to the Senate, where several proposed amendments were voted down, and it was promptly passed without debate by a vote of 26 to 13. On August 10, 1846, the bill was signed by President James K.

Polk, and the Smithsonian Institution was at last a reality, just twenty years after James Smithson wrote his will in London.

This Act establishing the Smithsonian permitted of considerable latitude in interpretation in certain sections and went into minutest detail in others. In full, it would make perhaps ten or twelve pages of this book; greatly condensed, it was in substance as follows:

A BILL TO ESTABLISH THE "SMITHSONIAN INSTITUTION" FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN

Preamble. Rehearses the facts as to Smithson's bequest and the acceptance by the United States, and directs that the President and Vice President of the United States, the Secretary of State, the Secretary of the Treasury, the Secretary of War, the Secretary of the Navy, the Postmaster-General, the Attorney-General, the Chief Justice, the Commissioner of the Patent Office of the United States, and the Mayor of the City of Washington, during the time for which they shall hold their respective offices, and such other persons as they may elect honorary members, be constituted an "Establishment" by the name of the Smithsonian Institution.

Section 2. Provides for the investment of the Smithson fund in the United States Treasury and perpetual payment of the interest thereon; also appropriates out of the accrued interest a sum for the erection of a suitable building.

Section 3. Provides that the business of the Institution shall be conducted at the City of Washington by a Board of Regents to be composed of the Vice President of the United States, the Chief Justice, and the Mayor of the City of Washington, together with three members of the Senate and three members of the House of Representatives, and six other persons. The act then provides for the manner of appointment, the time of service, the

Robert Dale Owen, Member of Congress from Indiana, a leader in the formation of the Smithsonian and member of the first Board of Regents

filling of vacancies, the election of a Chancellor and Secretary of the Board of Regents and of an executive committee, as well as for the payment of money needed for conducting the Institution; also, an annual report to be submitted to Congress.

Section 4. Provides for the selection of a suitable site for a building.

Section 5. Provides for the erection of a building of plain and durable materials, of sufficient size for rooms to contain objects of natural history, including a geological and mineralogical cabinet, a chemical laboratory, a library, a gallery of art, and the necessary lecture rooms; also gives the Board of Regents authority to contract for the erection of this building.

Section 6. Enacts that in proportion as suitable arrangements can be made for their reception, all objects of art and of foreign and curious research and all objects of natural history, plants, geological and mineralogical specimens, belonging or hereafter to belong to the United States, which may be in the City of Washington shall be deposited in the building to be erected; also new specimens to be so arranged; also minerals, books, and other property of James Smithson to be preserved in the Institution.

Section 7. Enacts that the Secretary of the Board of Regents shall take charge of the building and contents, shall discharge the duties of librarian and of keeper of the museum, and may employ assistants, and provides for their compensation.

Section 8. Provides for meetings at which the President or Vice President of the United States shall preside, and appropriates from the Smithson income a sum not exceeding twenty-five thousand dollars annually for the formation of a library.

Section 9. Enacts that moneys accrued as interest upon the fund, not herein appropriated, may be disposed of by the Board of Regents as they may direct.

Section 10. Enacts that one copy of all copyrighted books, engravings, maps, etc., shall be sent to the Librarian of the Smithsonian Institution, and one to the Librarian of Congress.

Section 11. Enacts that there is reserved to Congress the right of altering, amending, adding to, or repealing any of the provisions of this act; *Provided*, that no contract, or individual right, made or acquired under such provisions, shall be thereby divested or impaired.

Thus was the Smithsonian founded by Congress, and although its slowness in acting was bitterly criticized on all sides, nevertheless in the end it proved to have been of great advantage, and the provisions of the Act have been little changed. Several minor provisions, indeed, were afterwards repealed, including that which directs that one copy of every copyrighted publication shall be sent to the librarian of the Smithsonian. The Copyright Office is now in the Library of Congress exclusively.

Public opinion was educated and the views of Congress itself were enlightened by the thorough and protracted discussions. The weakness of certain schemes for the disposal of the Smithson money was exposed, and the better features of the various plans, which were able to stand the acid test of several years of discussion, were incorporated in some form in the final bill. Thus the final act of incorporation, as is nearly always the case in such matters, was a compromise, containing elements injected by many minds; and the credit for the organization must be divided among several distinguished men of that day who participated in the debates. The names which stand out most prominently in the work of establishing the Smithsonian are those of John Quincy Adams, Joel R. Poinsett, Rufus Choate, Richard Rush, Robert Dale Owen, Benjamin Tappan, and William J. Hough.

Those who had been opposed to the bill as it was passed, although defeated in the final vote, attempted several times in the following months to alter the Act of

Incorporation. Among these proposals of changes was that of Representative Johnson, of Tennessee, who wished to change the Smithsonian Institution as established to the "Washington University, for the benefit of indigent children of the District of Columbia," and another attempted change was to add to the Institution a department for gathering and publishing information on agriculture, common-school education, political economy, and the useful arts. These proposals were thrown out, and the House settled the matter by adopting a resolution stating that it was inexpedient to make any of the suggested changes in the Act establishing the Smithsonian.

Soon after the bill was signed by the President, the first Board of Regents was appointed in the specified manner, this first Board consisting of Vice President George M. Dallas; Chief Justice Roger B. Taney; Mayor William W. Seaton, of the City of Washington; Senators George Evans of Maine, Isaac S. Pennybacker of Virginia, and Sidney Breese of Illinois; Representatives William J. Hough of New York, Robert Dale Owen of Indiana, and Henry W. Hilliard of Alabama; members at large, Hon. Rufus Choate of Massachusetts, Hon. Gideon Hawley of New York, Hon. Richard Rush of Pennsylvania, and Hon. William C. Preston of South Carolina; and two members of the National Institute, Dr. Alexander Dallas Bache and Col. Joseph G. Totten.

A committee on organization was appointed, and after analyzing the Act of Incorporation and expressing its opinion regarding the interpretation of the various provisions, this committee took up the task of finding a suitable person for Secretary of the Institution. Realizing the broad powers delegated by the Act to this position, and recognizing that their selection of the first Secretary would largely influence the future development of the Institution, the committee adopted the following resolution:

"*Resolved*, that it is essential, for the advancement of the proper interests of the trust, that the Secretary of the Smithsonian Institution be a man possessing weight of character and a high grade of talent; and that it is further desirable that he possess eminent scientific and general requirements; that he be a man capable of advancing science and promoting letters by original research and effort, well qualified to act as a respected channel of communication between the Institution and scientific and literary individuals and societies in this and foreign countries; and, in a word, a man worthy to represent, before the world of science and of letters, the Institution over which this Board presides."

The first Board of Regents did its work expeditiously, although most carefully. Having held its first meeting in September, 1846, before the year was up they had determined their own policy, selected the plan for the building to be erected for the Institution, and had found the right man for Secretary in the person of Professor Joseph Henry, of New Jersey, whose reputation was already world-wide through his pioneer researches in the field of electromagnetism. In electing Henry, the Regents approved the plan of organization for the Smithsonian which he had previously submitted. Entering at once upon the task of putting into effect his plan for the increase and diffusion of knowledge among men, Professor Henry devoted the balance of his life, thirty-two years, to this work, and to his able and farsighted administration of its early affairs the Institution largely owes the broad foundations upon which it has been built and its honorable reputation in the world of science.

Upon Henry's death in 1878, the Assistant Secretary, Spencer Fullerton Baird, at that time America's leading biologist, took up the duties of Secretary. Dying after a distinguished unbroken connection of thirty-seven years with the Smithsonian, he in turn was succeeded in the year 1887 by Samuel Pierpont Langley, physicist, astron-

omer, and pioneer in aviation. Langley died in 1906, when he was followed as Secretary by Charles Doolittle Walcott, geologist and paleontologist, who carried forward the affairs of the Institution vigorously and successfully until his death in 1927, insuring its honorable standing and high rank among research establishments. The present Secretary is Dr. Charles Greeley Abbot, astrophysicist, thus continuing the unwritten rule of alternating the Secretaryship between leaders in the natural sciences and in physical science.

CHAPTER XVI

EIGHT GREAT REGENTS

In the long list of Smithsonian Regents from 1846 to the present time there have been vice presidents, several of whom have later become President, chief justices, distinguished senators and representatives, and citizens eminent in education, science, diplomacy, and literature. Among the citizen Regents in particular we find names to conjure with, of those who have taken the keenest interest in the affairs of the Institution and have served long and useful terms.

The Board is now composed of the Vice President of the United States and the Chief Justice, both *ex-officio* members; three United States Senators; three members of the House of Representatives; and six citizens, two of whom must be residents of the City of Washington, and of the other four no two must be from the same State. This last provision was inserted obviously to avoid sectionalism, and the selection of Regents has always been carefully made to include eminent men from all parts of the country.

The duty of the Board is to oversee the business of the Institution. The Secretary of the Board is also the Secretary of the Institution, and is the executive officer in direct charge of its operations. He is responsible for the expenditure of the Institution's funds and for the actual management of its affairs. The presiding officer of the Board is the Chancellor of the Smithsonian Institution, who is elected by the Regents from among them-

selves. The choice has always fallen on either the Vice President or the Chief Justice.

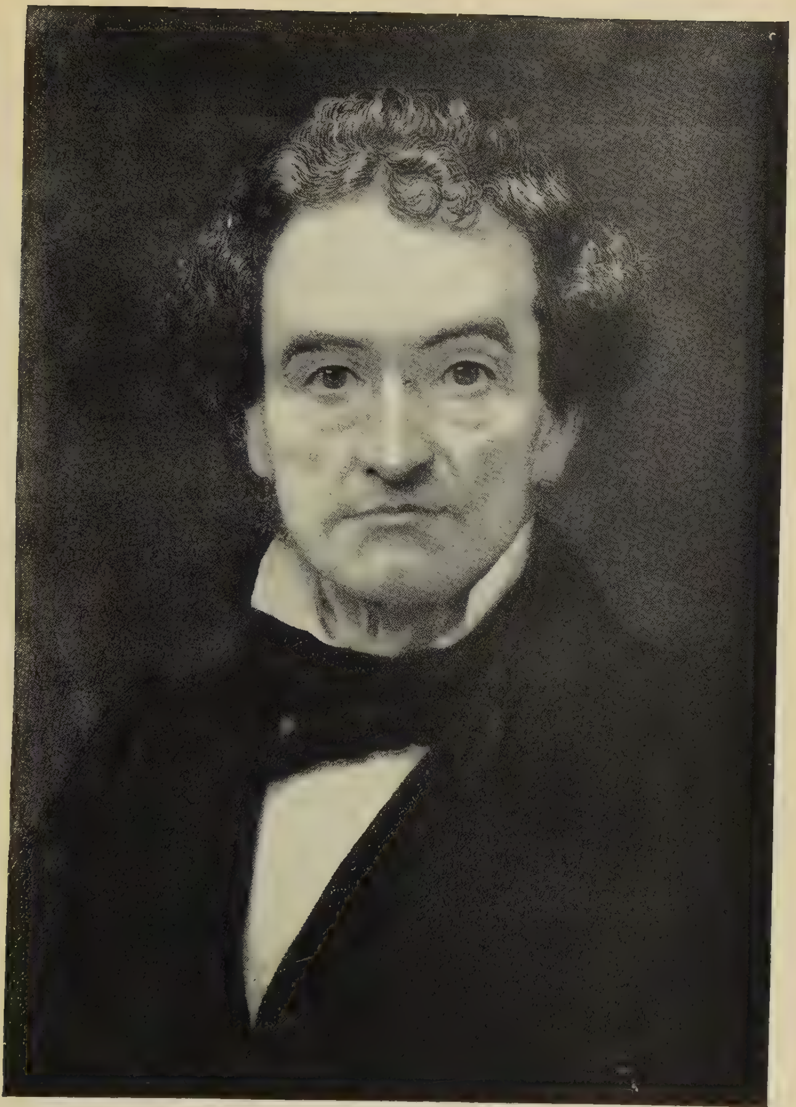
Although the whole Board meets usually only once or twice a year, nevertheless it keeps in close touch with the Institution's affairs through its permanent and executive committees, which are frequently consulted by the Secretary. In order to show the character of this governing body, we shall portray eight from among the more than two hundred distinguished men who have served as Regents, whose terms of service cover a large part of the Institution's existence, and who represent the various walks of life found on the Board.

Rufus Choate. 1846–1859

Rufus Choate, lawyer, politician, and member of Congress, was one of the striking figures of the days of Webster, Clay, and Calhoun. Born in Massachusetts in the last year of the eighteenth century, he graduated from Dartmouth College in 1819, and after a year as tutor at his college, he took up the study of law at Cambridge. Following this, he spent a year studying at Washington, and he first engaged in the practice of his chosen profession in South Danvers, Massachusetts. Here his skill and eloquence, combined with his unremitting diligence and faithfulness soon brought him a good share of the business of the surrounding country. From the very beginning of his career he made it a rule to put forth his utmost efforts in every case confided to him, regardless of its seeming importance or the pecuniary reward involved. One very stormy night during these early years, he was called out of bed to draw up the will of a dying man who lived several miles away. He promptly arose, made the unpleasant trip, rapidly drew up the will, and returned home. He did not immediately go back to sleep, however, and as he lay revolving in his mind the wording of the document, an omission suddenly occurred

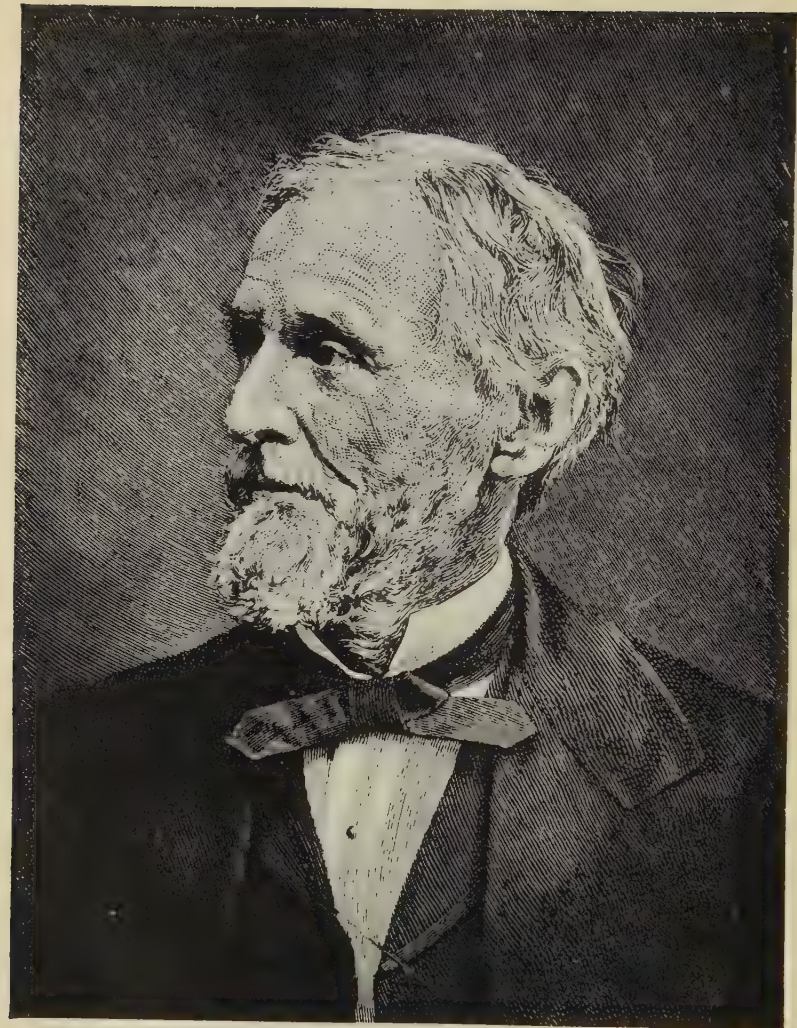
to him which might possibly lead to confusion. He immediately arose a second time, dressed, and again made the journey through the storm, and having explained the omission, added a codicil to the will which covered all contingencies. This was characteristic of his thoroughness and devotion to duty, characteristics which contributed largely to his rapid rise. He represented the town of Danvers in the State legislature, and shortly thereafter was elected to serve as a Representative from the State of Massachusetts in the United States Congress. He next became a United States Senator from Massachusetts, and even in this august body his impressive eloquence soon won him admiration and high esteem.

But Rufus Choate is best known as a lawyer. His periods of holding public office he looked upon as interludes in the real business of his life, and although he entered into politics and statesmanship with his characteristic zeal and ability, he was always glad to return to his beloved profession. In this he will be remembered as one of the greatest advocates of all time. His brilliance, his wit, his thorough knowledge of the law, his resourcefulness and dogged determination in the face of almost certain defeat made him justly famous throughout the Nation. There are countless anecdotes of Choate's wit during his long legal career, but I can give only one to illustrate this outstanding characteristic. In 1847 he was engaged by citizens of Massachusetts to prevent the acceptance of the report of a joint commission to establish the boundary between that State and Rhode Island. A part of the boundary line was described in the report thus: ". . . thence to an angle on the easterly side of Watuppa Pond, thence across the said pond to the two rocks on the westerly side of said pond and near thereto, then westerly to the buttonwood tree in the village of Fall River, ..." In his pointed comments on such a boundary line, Choate said, "A boundary line between two sovereign States described by a couple of stones near



Rufus Choate, 1799–1859. Famous lawyer and Member of Congress; regent of the Smithsonian from 1846 to 1859

PLATE 85



Jefferson Davis, 1808–1889, President of the Confederacy; regent of the Smithsonian Institution from 1847 to 1853

a pond, and a buttonwood sapling in a village! The commissioners might as well have defined it as starting from a blue jay, thence to a swarm of bees in hiving time, and thence to five hundred foxes with firebrands tied to their tails!"

During Choate's service in the Senate, the disposition of the Smithson bequest came up, and none displayed a more ardent interest in it than he. He took an active part in all the debates on the subject, favoring throughout the application of the fund to the formation of a noble library, equal to any in the world. His plan did not prevail, but as a compromise, a clause was inserted in the final Act of Incorporation of the Smithsonian providing for the use of a certain amount of the income for the purposes of a library. As a natural result of his active part in the establishment of the new Institution, he was appointed a member of the first Board of Regents, on which he served with his usual distinction.

Jefferson Davis. 1847–1853

Jefferson Davis, next to Abraham Lincoln perhaps the most striking figure during the stormy days of the Civil War, was born in Kentucky in 1808. It is a strange coincidence that he, the future President of the Confederate States, and Abraham Lincoln, the future President of the United States, were born only eight months apart in time and forty miles apart in distance. Davis received an excellent education for that time, attending several schools and academies, and finishing with a military training at West Point. Immediately after his graduation, he entered upon a military career, and took part in the "Black Hawk" Indian war. After the defeat of the Indians and the capture of Black Hawk, Lieutenant Davis was detailed to take him to prison at St. Louis. The old chief was later transferred to Fort Monroe, where Davis himself was destined to be imprisoned at the close of the Civil War.

Davis married Sarah Knox Taylor, daughter of General Zachary Taylor, later President, but shortly after their marriage his young wife contracted the dreaded chills-and-fever malady of the South and died. Davis was so saddened by this tragedy that he went into seclusion on his brother's plantation in Mississippi, where he remained for five years. At the end of this time he emerged from the obscurity of the wilderness and entered politics, and his public career dates from 1843.

In 1845 he was elected to Congress from Mississippi, and he immediately attracted wide attention through his ability and his brilliant speeches on the important issues of the day. The following year he served with great distinction as a colonel in the Mexican War, his personal bravery and qualities as a military leader being demonstrated on many occasions, particularly at the famous battle of Buena Vista, during which he was wounded but remained in the saddle until the battle was won. After the Mexican War, Jefferson Davis again appeared in public life, as United States Senator, and later as Secretary of War. He was exceptionally influential as a cabinet officer, and introduced desirable improvements into the Army. When the problems of States rights and slavery became serious, Davis was returned to the Senate, and often expressed himself ardently in favor of the individual rights of the States. When at last his own State of Mississippi withdrew from the Union, he left the Senate and returned home. He took leave of the Senate in a speech of great power in which he said in part:

"I rise, Mr. President, for the purpose of announcing to the Senate that I have satisfactory evidence that the State of Mississippi, by a solemn ordinance of the people in convention assembled, has declared her separation from the United States. . . . It is known to Senators who have served with me here that I have for many years advocated, as an essential attribute of State sovereignty, the right of a State to secede from the Union. . . . A

great man who now reposes with his fathers, and who has been often arraigned for want of fealty to the Union, advocated the doctrine of nullification, because it preserved the Union. It was because of his deep-seated attachment to the Union, his determination to find some remedy for existing ills short of a severance of the ties which bound South Carolina to the other States that Mr. Calhoun advocated the doctrine of nullification, . . . not to disturb the Union, but to be a means of bringing the [actions of their] agent [the Union] before the tribunal of the States for their judgment.

"Secession belongs to a different class of remedies. It is to be justified on the basis that the States are sovereign. . . . It is by confounding of nullification and secession that the name of a great man, whose ashes now mingle with mother earth, has been invoked to justify coercion against a seceded State. The phrase, 'to execute the laws,' was an expression which General Jackson applied to the case of a State refusing to obey the laws while yet a member of the Union. That is not the case which is now presented. . . . If it be the purpose of gentlemen, they may make war against a State which has withdrawn from the Union; but there are no laws of the United States to be executed within the limits of a seceded State. A State finding herself in the condition in which Mississippi has judged she is, in which her safety requires that she should provide for the maintenance of her rights out of the Union, surrenders all the benefits (and they are known to be many), deprives herself of all the advantages (and they are known to be great), severs all bonds of affection (and they are close and enduring), which have bound her to the Union; and thus divesting herself of every benefit, taking upon herself every burden, she claims to be exempt from any power to execute the laws of the United States within her borders. . . .

"I see around me some with whom I have served long; there have been points of collision; but whatever of offense

there has been to me, I leave here; I carry with me no hostile remembrance. Whatever offense I have given which has not been redressed, . . . I have, Senators, in this hour of our parting, to offer you my apology for any pain which, in the heat of discussion, I have inflicted. I go hence unincumbered of the remembrance of any injury received, and having discharged the duty of making the only reparation in my power for any injury offered.

"Mr. President and Senators, having made the announcement which the occasion seemed to me to require, it only remains for me to bid you a final adieu!"

With the formation of the Confederacy, Davis was first selected as commander-in-chief of the volunteer troops of the State of Mississippi, but with the meeting of the Provisional Congress of the Confederate States, he was elected President of the Confederacy, and shortly afterwards established the capital at Richmond, Virginia. With unwavering fidelity to his beliefs and ideals, Jefferson Davis served the South throughout the terrible years of the Civil War. He was in turn praised and bitterly assailed for his policies, and biographers still differ radically in their estimates of his administration. Upon the final defeat of the South, Davis was accused of implication in the assassination of Lincoln, and was incarcerated in Fort Monroe under heavy guard for two years. He was never tried, but was released on bond, and after traveling for a year or two, settled near Biloxi, Mississippi, for the purpose of writing a history of the Confederacy, which he completed in 1881. Jefferson Davis died in 1889 at the age of eighty-one years.

During his career in the United States Senate, Davis was a member of the Board of Regents of the Smithsonian Institution, and took an active interest in its affairs. During the debates in Congress on the foundation of the Institution, he also appeared prominently, and it was he who insisted that the United States Government must make good the loss of a large part of the Smithson fund

through its investment in State bonds which later became worthless.

Louis Agassiz. 1863–1873

On the roll of Smithsonian Regents are the names of several men who will stand for all time as leaders in the realm of science. Outstanding even among these is Professor Louis Agassiz, founder of the Museum of Comparative Zoology of Harvard University. Agassiz was born in Switzerland in 1807 and from his earliest youth showed a marked predilection for natural history. His parents, recognizing his ability in these lines, encouraged his tendency and he was given a most excellent and thorough education, attending college at Lausanne, the medical school at Zurich, and the universities at Heidelberg and Munich. Although his interests were entirely in the field of natural history, his parents insisted upon his taking a degree in medicine, that he might have a profession in case a scientific career should fail to provide him with a living. While still at the university he began to make his mark in the scientific world, being recognized by such men as Humboldt and Cuvier as one of the most promising of the coming generation of naturalists.

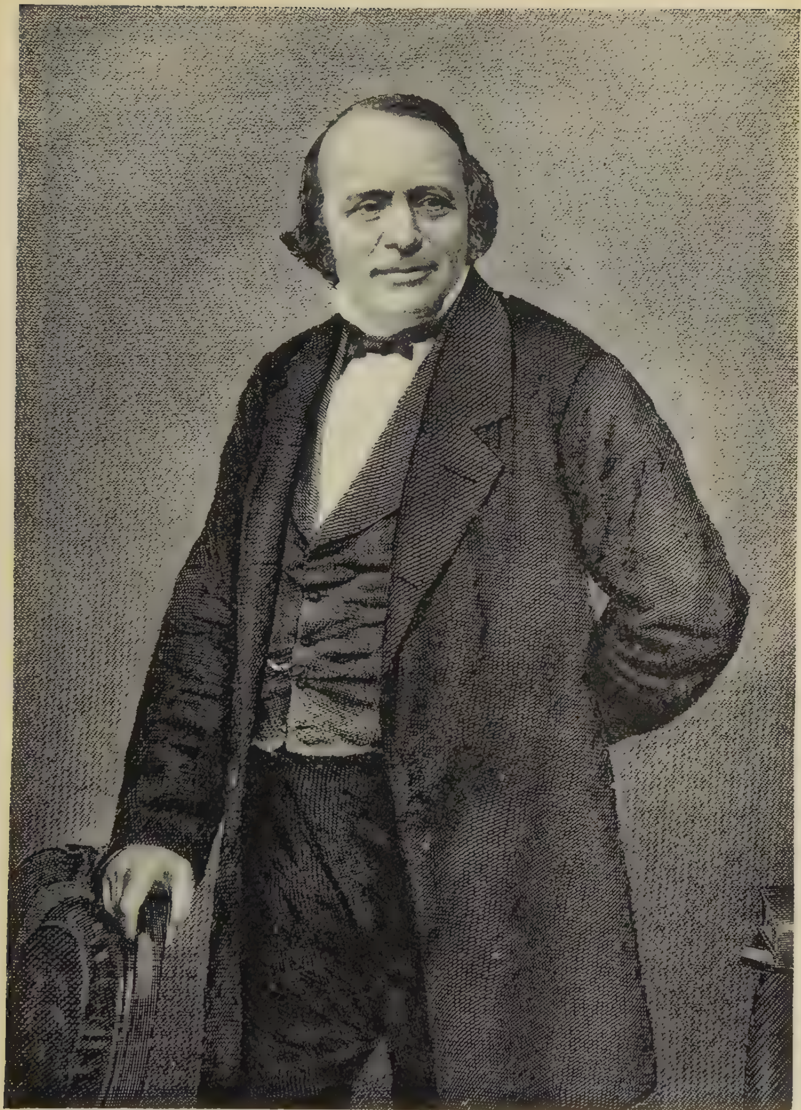
After receiving his degree, he accepted a professorship in natural history at Neuchatel, and from his first lecture he was a brilliant success as a teacher. Here he began his first great scientific work, a monographic account of the fossil fishes, upon which he spent every moment which could be spared between lectures. The expenses connected with the preparation of the plates kept him in constant financial embarrassment, but he was from the beginning ever ready to sacrifice everything to the advancement of science. The publication of the first parts of the "Poissons fossiles" brought him instant recognition from scientists throughout the world, and he was invited to come to England to study the collections there. He next became interested in glaciers and their relation to geology and natural history, and over a period of years conducted

epoch-making researches on the European glaciers, at the same time continuing his teaching as well as a number of important zoological projects. His energy and enthusiasm for scientific work were unbounded, and at one time the excessive use of his eyes threatened to bring on blindness, forcing him to remain in a darkened room for several months, during which time he continued to study fossils by the sense of touch alone, dictating his notes as he worked.

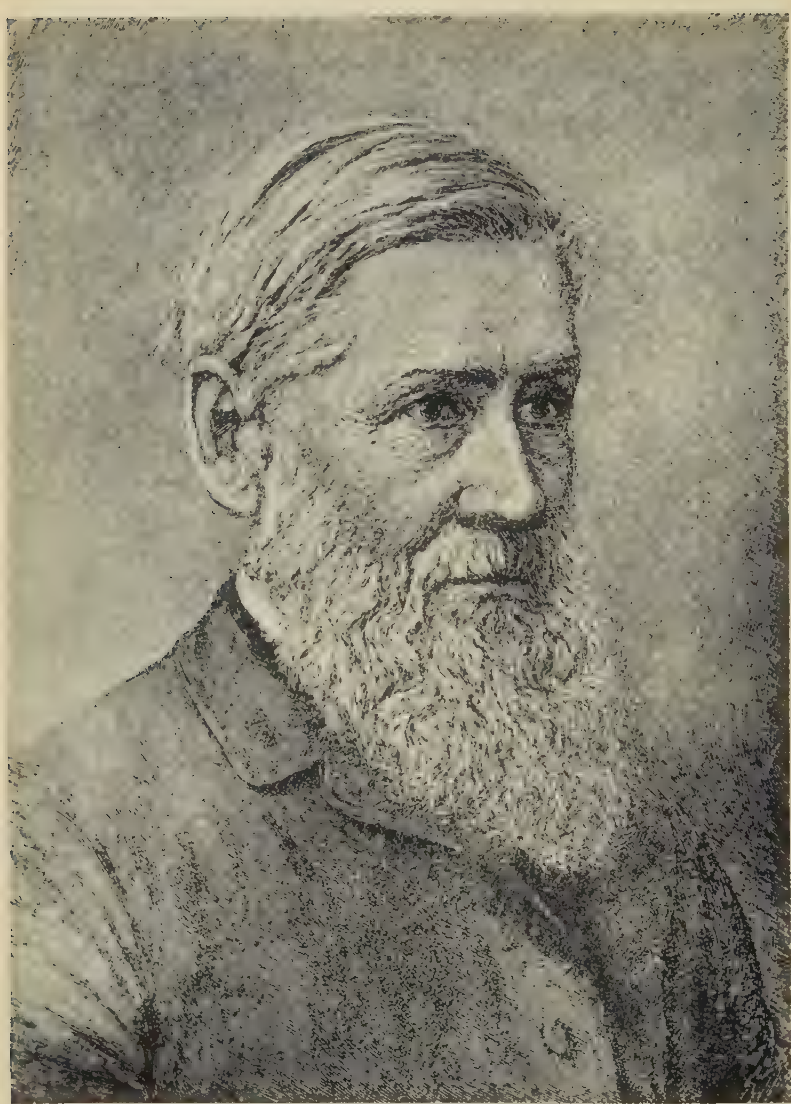
In 1846, the year of the founding of the Smithsonian, Agassiz set sail for America, and here he was an immediate success. He began his career in the New World by giving a course of lectures in natural history in Boston, and soon accepted the chair of natural history at the Lawrence Scientific School of Harvard University, at Cambridge. Here he remained for the rest of his life, teaching, conducting his now famous researches, and organizing the Museum of Comparative Zoology.

Agassiz was an inspiring lecturer, instilling in his students a love of science and imparting to them some of his own enthusiasm. He continued to devote every spare moment to zoological research, and upon being offered a large sum of money to deliver popular lectures in the West, he made the characteristic reply: "I cannot afford to waste my time in making money." Agassiz, however, did much to popularize science in America, and a scientist of his own time has said of him:

"He made science popular, because in him science was individualized in the most fascinating and persuasive of human beings. All the rest of us are more or less dominated by our special lines of investigation, or so infirm in physical health, or so unsympathetic with ignorant people, or so supercilious, or so controlled by some innate 'cussedness' of disposition, that we cannot readily adapt ourselves to the ways of men of the world; but Agassiz, with his enormous physical health and vitality, and his capacity to meet all kinds of men on their own level,



Louis Agassiz, 1807-1873, foremost American naturalist; regent of the Smithsonian from 1863 to 1873



Asa Gray, 1810–1888. Leading American botanist of his time; regent of the Smithsonian Institution from 1874–1888

drew into our net hundreds of people, powerful through their wealth or their political influence, who would never have taken any interest in science if they had not first been interested in Agassiz. And these men were the men who gave us the money we needed for the extension of scientific knowledge and the promotion of scientific discovery. Agassiz is a great scientific intelligence; but he is even greater, considered as an immense scientific force."

In 1852, Agassiz delivered a course of lectures at the Smithsonian Institution, and he was soon after elected a member of the Board of Regents, remaining upon the Board until his death in 1873.

Asa Gray. 1874–1888

Another name renowned in science which adds luster to the governing body of the Smithsonian Institution is that of Asa Gray, the American botanist, whose career presents a close likeness to that of Louis Agassiz. Gray is to botany what Agassiz is to zoology, and the two did much toward setting America on the road to eminence in scientific research. Born in New York State in 1810, only three years after Agassiz, Gray, following his elementary education, was also sent to medical school by his parents. Like Agassiz, also, he did not take up the practice of medicine after graduation, but immediately entered upon the study which had so strongly attracted him at school—that of botany.

He further resembled Agassiz in being a tremendous worker—practically every waking hour of his life was spent in studying botany, in teaching it, or in writing books on it. After a few years devoted to teaching botany at Hamilton College and later at the Utica High School, Gray accepted the position of assistant to Dr. John Torrey of the Medical School of New York, although in a short time, through his excellent work, his status became that of a colleague of Doctor Torrey, and the two worked to-

gether on botanical problems for many years. In 1836, the famous Wilkes Exploring Expedition was organized, and Gray was offered the position of botanist to the expedition, but the sailing was so many times postponed and Gray became so involved and interested in his work on the "North American Flora," of which Doctor Torrey had invited him to be a joint author, that he sent in his resignation as botanist of the expedition, much to his regret. By the time the expedition actually set sail, however, two parts of the famous "Flora" were already out.

He next accepted the chair of botany at the University of Michigan with the proviso that he should have a year abroad for study. This proved to be an eventful year, for Gray studied all of the important botanical collections of Europe and was welcomed by all of the eminent European botanists. Returning, he took up the preparation of the "Flora" with renewed vigor and a broader knowledge, and the first volume appeared in 1840 and the second in 1843. Gray did not take up his duties at the University of Michigan, as it would be impossible for him to carry on his publications so far from the herbaria and libraries of New York, and in 1842 he entered upon his life work at Harvard, where he was installed in the Fisher professorship of natural history and as director of the botanical garden. Here he remained for the rest of his life, teaching, conducting original researches, and publishing innumerable short papers, monographs, and textbooks. His renown became world-wide, and one of his major occupations consisted in reviewing and criticizing in print all major contributions to the science of botany. As a critic he was eminently fair and constructive, but did not hesitate to condemn work which seemed to him worthless or worse. In reply to an objector against one of his severest criticisms, he wrote:

"In my heart I would have been more tender than you, but I cannot shrink from the duty which such a position

imposes upon me. If you were in the position that I am, with a short life and a long task before you, and just as you thought the way was clear for progress someone would dump cartloads of rubbish in your path, and you had to take off your coat, roll up your sleeves, and spend weeks in digging that rubbish away before you could proceed, I should not suppose you would be a model of amiability."

Gray was one of the earliest and most ardent supporters of Darwin's theories of evolution, and his support was greatly appreciated by Darwin. He wrote, "His [Gray's] generosity in getting my views a fair hearing and not caring himself for unpopularity had been most unselfish, I would say noble."

Gray's name will stand for many generations as the leading botanist of his time and among the greatest of all time. His "Manual," his "Synoptical Flora of North America," and his textbooks and popular works on botany stimulated a widespread interest in this science in America, and his standing among men of his own profession is attested by the large number of genera and species of plants named for him. Gray was a member of the Smithsonian Board of Regents from 1874 until his death in 1888.

James Dwight Dana. 1874–1877

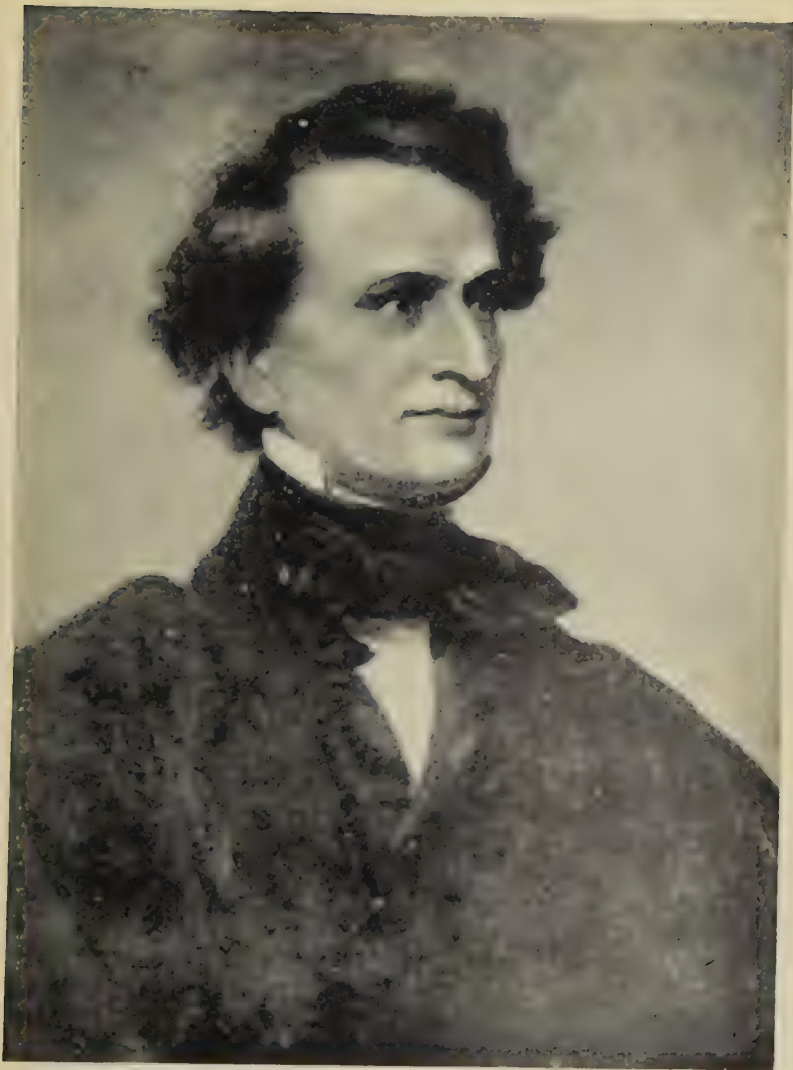
James Dwight Dana forms the third of a great triumvirate of scientists who in the early stages of the development of science in America did much to put it on a broad and firm foundation. These three—Agassiz, zoologist; Gray, botanist; and Dana, geologist and mineralogist—in serving for varying periods on the Board of Regents of the Smithsonian Institution contributed largely to its progress and reputation during the latter years of the last century.

Dana was born in Utica, New York, on February 12, 1813, and was educated at the Bartlett Academy in

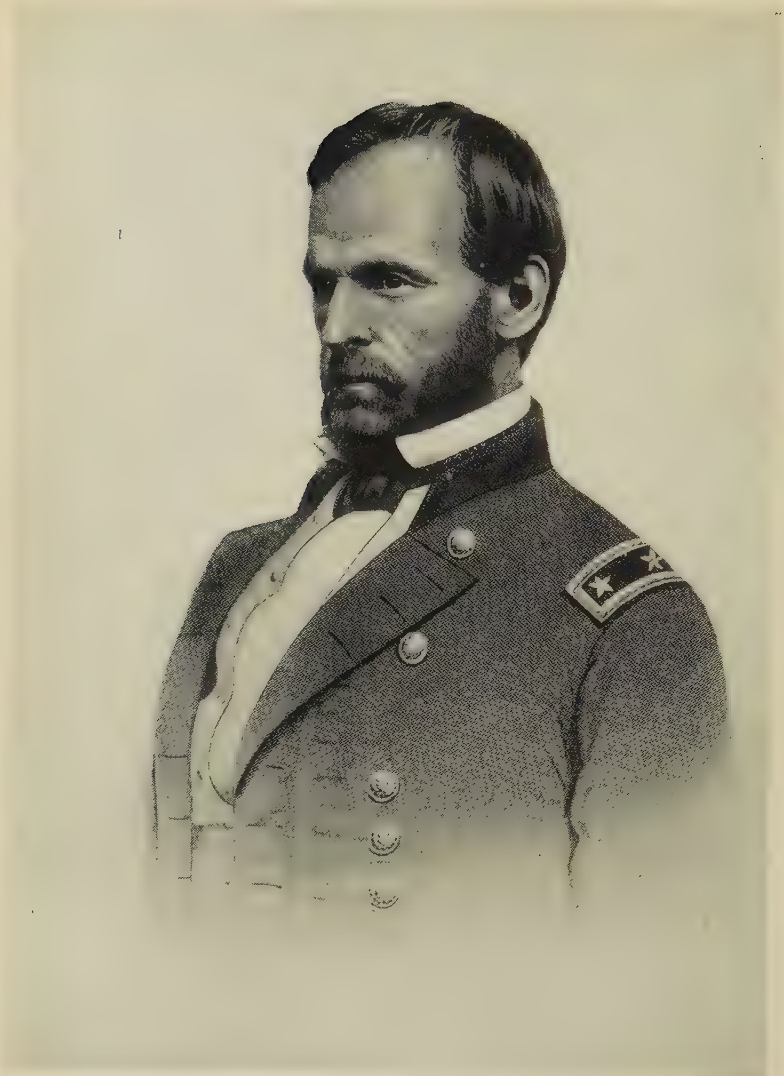
Utica, where under the excellent teaching of Mr. Edgerton, the natural history instructor, his inborn taste for the study of science was strongly developed. Short expeditions to the surrounding country in search of minerals gave him a special interest in mineralogy which proved to be his life work, although later broadened to include all geology. He next entered Yale and just before graduation accepted the position of instructor in mathematics to the Navy midshipmen on a cruise to the Mediterranean. In 1836 he returned to Yale and remained there for two years, during one of which he served as assistant to Professor Silliman, professor of Chemistry. In 1838 he sailed with the Wilkes Exploring Expedition as mineralogist and geologist. This famous expedition, which for four years cruised in the out-of-the-way parts of the globe, proved to be an extraordinary stimulus to Dana's work, and the knowledge gained during these four years was of profound influence on his entire subsequent career. The voyage was not without unpleasant incidents, however, and in the introduction to one of his books, Dana, after recounting the beauties of nature encountered in various lands, describes thus graphically some of the more exciting phases of the expedition:

"Even the beauty of natural objects had, at times, a dark background. When, for example, after a day among the corals, we came, the next morning, upon a group of Feejee savages with human bones to their mouths, finishing off the cannibal feast of the night.

"Other regions gave us harsh scenes. One—that of our vessel in a tempest, fast drifting towards the rocks of Southern Fuegia, and finding anchorage under Noir Island, but not the hoped-for shelter from either wind or waves; the sea at times dashing up the black cliffs two and three hundred feet, and shrouding in foam the high, rocky islets, half obscured, that stood about us; the cables dragging and clanking over the bottom; one breaking, then another, the storm still raging; finally, after the



James Dwight Dana, 1813–1895, leader in the development of American geology and mineralogy; regent of the Smithsonian Institution from 1874 to 1877



General William Tecumseh Sherman, 1820–1891, of Civil War fame; regent of the Smithsonian from 1871 to 1883

third day, near midnight, the last of the four cables giving way, amid a deluge of waters over the careering vessel from the breakers astern, and an instant of waiting among all on board for the final crash; then, that instant hardly passed, the loud, calm command of the captain, the spring of the men to the yard-arms, and soon the ship again on the dark, stormy sea, with labyrinths of islands, and the Fuegian cliffs to leeward; but, the wind losing somewhat of its violence and slightly veering, the ship making a bare escape as the morning dawned with brighter skies."

He then describes vividly the wreck of his vessel, the *Peacock*, on a bar at the mouth of the Columbia River, and concludes: "But these were only incidents of a few hours in a long and always delightful cruise."

Dana returned to this country in 1842, and for the thirteen years following, his time was largely given to the study and preparation for publication of the material collected by the Wilkes Expedition. During this period, however, he also issued three editions of his famous "System of Mineralogy," the first edition of which he had published in New Haven when only twenty-four years of age, and two editions of the "Manual of Mineralogy." In 1850 began his connection with the faculty of Yale University which was to continue with interruptions due to ill health until 1890. The severe and continuous labor involved in the preparation of his reports on the Wilkes Expedition material finally broke his health, and although he continued in active service for thirty-five years longer, it was always a losing struggle against poor health, and for the rest of his life he was forced to conserve his energies with the greatest care.

Dana's studies and researches of a lifetime are all recorded in his numerous textbooks, general works, and technical articles on mineralogy and geology, and the name of Dana is permanently associated with the development of geological science in America. He was elected

to membership on the Smithsonian Board of Regents in 1874, the same year that Asa Gray became a member, but after serving a few years with distinction, his declining health made it necessary for him to give up all extraneous duties and he was forced to resign as a Regent.

William Tecumseh Sherman. 1871–1883

General William Tecumseh Sherman won his way to the front rank among the outstanding military leaders of the Civil War. At the head of a division of the Union Army, he was in the thick of the fighting from beginning to end, and he was responsible in large measure for the victory of the North. His famous march through Georgia to the sea will never be forgotten. At its conclusion he sent the following message which reached President Lincoln on Christmas Day, 1864: "I beg to present you as a Christmas Gift the city of Savannah, with one hundred and fifty heavy guns and plenty of ammunition, and also about twenty-five thousand bales of cotton." This message naturally caused great rejoicing throughout the North, for it was felt that the end of the struggle was drawing near.

Sherman was born in 1820, in Ohio, and after a preliminary education, entered West Point, where he graduated in 1840. After serving for some years in the Army as lieutenant and later as captain, he resigned to enter the banking business, in which he was successfully engaged in San Francisco and later in New York, for several years. When the firm which he represented closed its New York office, he tried the practice of law and later farming, and in 1859 he was chosen as superintendent of a new military school in Louisiana. Here he remained until it was obvious that civil war must come, when he wrote to the governor of Louisiana in part as follows:

"Sir:

"As I occupy a quasi-military position under the

laws of the State, I deem it proper to acquaint you that I accepted such position when Louisiana was a State in the Union, and when the motto of this seminary was inserted in marble over the main door: 'By the liberality of the General Government of the United States. The Union—*esto perpetua.*' Recent events foreshadow a great change, and it becomes all men to choose. If Louisiana withdraws from the Federal Union, I prefer to maintain my allegiance to the Constitution as long as a fragment of it survives, and my stay here would be wrong in every sense of the word."

In the spring of 1861 Sherman was appointed a colonel of infantry in the Union Army, and shortly after was made a brigadier general. Beginning his active service in the disastrous battle of Bull Run, he fought successively at Shiloh, Corinth, Memphis, Vicksburg, Chattanooga, Meridian, and Atlanta, through Georgia to Savannah, and north through the Carolinas. In all of these campaigns he showed himself to be a vigorous and able leader, and he was loved and respected by his men, who knew him as "Uncle Billy." In 1862 he was made a major general, and after the War he was promoted to lieutenant-general in 1866 and general in 1869. He would undoubtedly have been nominated for the Presidency in 1884 had he not persistently clung to a resolution made shortly after the War never to enter political life. General William T. Sherman was one of the most picturesque figures of the Civil War period, and many of his exploits are preserved in song and story. The song commemorating his most famous campaign, the refrain of which ends with "While we were marching through Georgia," has kept fresh the memory of one of the outstanding heroes of American history.

Sherman was a man of keen intellect and broad culture, and in 1871 he was elected by Congress as a citizen Regent of the Smithsonian Institution, being reelected in 1878.

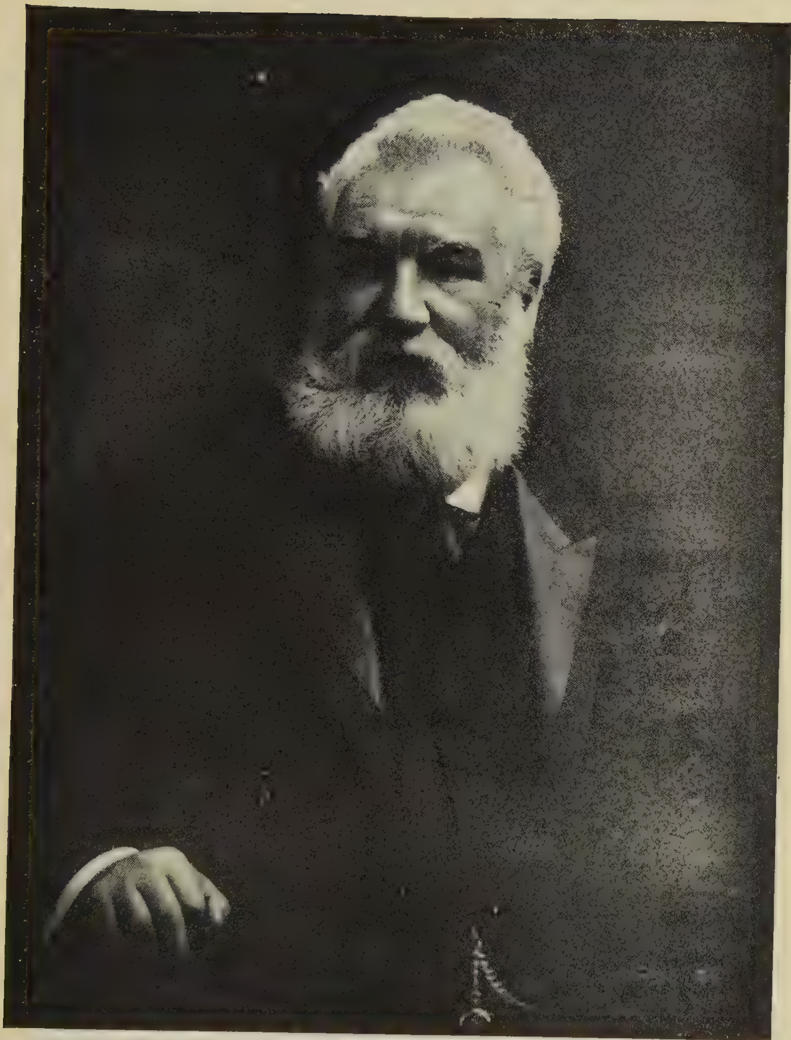
Alexander Graham Bell. 1899–1923

Alexander Graham Bell, one of America's greatest inventors, was a Regent of the Smithsonian Institution for a period of twenty-four years, serving during the entire time as a member of the executive committee of the Board. His active interest in the affairs of the Institution has perhaps not been surpassed by any other member of the Board, past or present, and a scientist himself, his name is closely associated with the activities of the Smithsonian during the first quarter of the present century.

Bell was born in Scotland and was educated at Edinburgh and London Universities. Coming to this country, he became interested in the problems of the deaf and soon entered upon a career of teaching the deaf-and-dumb, in which he was highly successful. He had already become interested in the problem of the telephone, and soon became so wrapped up in his experiments with this fascinating idea that his teaching was abandoned. He attacked the problem from the point of view of a student of sound, and to this he attributed his success in inventing the telephone while the electrical experts were still far from a practical solution. After several years of patient experiment, Bell finally succeeded, and in March, 1876, his assistant at a receiver in another part of the house heard over the wire, "Watson, come here, I want you." These words have since become as well known as Morse's first telegraph message, "What God hath wrought." Many years later, with the rapid development and expansion of the telephone, Bell repeated this first telephone conversation to the same assistant, Mr. Thomas A. Watson, from New York to San Francisco on the occasion of the opening of the first transcontinental telephone line.

After a severe struggle to establish the new invention of the telephone as a practical affair, it soon developed with amazing rapidity, and has become known as the

PLATE 90



Alexander Graham Bell, 1847–1922, inventor of the telephone; regent of the Smithsonian for twenty-four years

Colonel Charles A. Lindbergh receiving for his New York to Paris flight the Smithsonian's Langley Medal from Chief Justice William H. Taft, Chancellor of the Board of Regents of the Institution, December 8, 1927

most valuable single patent ever issued. Bell soon turned his inventive genius to other fields, and is known as the inventor of the graphophone, the photophone, the induction balance, and the telephone probe for painless detection of bullets in the human body. In addition, he has done a great deal for the benefit of the deaf, including the founding in 1887 of the Volta Bureau for the increase of knowledge relating to the deaf.

Doctor Bell maintained a summer home and laboratory on Baddeck Bay in Nova Scotia, and here he carried on the researches which most interested him. He was occupied for several years with problems connected with aeronautics, and was in close touch with Professor Langley during the latter's well-known experiments. He was present at the trials of the Langley machines on the Potomac River, and took the keenest interest in the whole project. He conducted his own researches in the most thorough manner, going back to the very beginning of each problem regardless of what had been done by others. He overlooked no details which might prove of value, and a neighbor on Baddeck Bay relates how he watched for an hour Doctor Bell, Doctor Langley, and Professor Simon Newcomb gravely occupied in dropping a cat back downward from a balcony in order to learn if possible how the animal turned itself in the air so as to land right side up. One of Doctor Bell's latest interests was the development of a hydroplane boat constructed on a new principle. Equipped with airplane propellers, it rose higher and higher on submerged planes as the speed increased until at a maximum speed it rested on a very slight supporting surface in the water. This craft attained a speed of over seventy miles an hour on Baddeck Bay.

Throughout a long and active life, Doctor Bell devoted himself to the working out of his ideas for the benefit of mankind, and he is typical of the body of distinguished men who have aided in the development of the Smithso-

nian Institution through active membership on the Board of Regents.

William Howard Taft. 1921–1930

It is given to few men to hold as many important offices in this country as William Howard Taft. U. S. Circuit Judge, Governor of the Philippine Islands, Secretary of War, President of the United States, and finally Chief Justice of the Supreme Court make up the impressive list of honors that reveals the estimation in which he has been held in the minds of the people of America.

Taft's career is probably too fresh in memory to need recounting, although some of the details may be forgotten. Born in Cincinnati in 1857, Taft received his education in the public schools of that city and later at Yale University, where he graduated second in his class in 1878. After completing his law course, he was occupied successively as law reporter for a Cincinnati newspaper, assistant prosecuting attorney, collector of internal revenue of the First District of Ohio, and assistant county solicitor of Hamilton County, and from that time on he continued to fill important public offices. For three years he held the position of judge of the Superior Court of Cincinnati, which he resigned in 1890 to become Solicitor General of the United States. Two years later he was made U. S. Circuit Judge for the Sixth Judicial District, which position he filled for eight years. In 1901 he was appointed by President McKinley the first civil governor of the Philippines, and here he carried out a difficult task with such success that the people of the islands did not wish to have him leave. In 1904 he was appointed Secretary of War. During his incumbency in this office he conducted a number of difficult missions among our island possessions. His election to the Presidency followed in 1908, and after completing his administration, he had the, for him, novel experience of a few years of private life during which he gave law courses at Yale University. In the year 1921 he was

called to preside over the Supreme Court of the United States.

Taft's outstanding personal characteristics were his straightforwardness, his simplicity, and above all his geniality. His humor is proverbial and he had a most contagious smile. In an address a few years ago, he referred to Theodore Roosevelt's division of all Presidents into two classes—one which interpreted the executive power broadly and exercised it strongly, the other which interpreted the power narrowly and exercised it sparingly. The first group Mr. Roosevelt concluded with himself and the second with Taft. Mr. Taft, with his famous chuckle, said this reminded him of the little boy who said to his father, "Dad, did you know I was the brightest boy in my class?" "Why, no," said the proud father, "when did the teacher tell you so?" "She didn't tell me," replied the lad, "I noticed it myself."

Upon his appointment as Chief Justice of the United States, Mr. Taft became *ex-officio* a member of the Smithsonian Board of Regents, and shortly thereafter, the office of Chancellor of the Institution being left vacant through the elevation of Vice President Coolidge to the Presidency, Mr. Taft was elected Chancellor and presiding officer of the Board of Regents. Through his interest in the affairs of the Institution and the wisdom of his counsel, he materially aided in promoting the work of the Smithsonian and in advancing its reputation.

Let these eight men, then, typify the more than two hundred who have guided the destinies of the Smithsonian —statesmen, scientists, soldiers, jurists, and educators. Eight others could have been selected who have been equally distinguished; in fact, the entire list of Smithsonian Regents amounts practically to an American Hall of Fame for that period.

CHAPTER XVII

FOUR GREAT SECRETARIES

It is in the nature of such an institution as the Smithsonian that its destiny must be shaped and its reputation formed chiefly by the successive men at the head of it—the Secretaries. This position is one of broad powers and full responsibility, and the Board of Regents have from the beginning selected men of the highest caliber, outstanding through their achievements in science and their marked ability as administrators. Four men held the position of Secretary of the Smithsonian Institution from 1846 to 1927, and though this was not strictly intentional, each has represented in his own researches a different branch of science. Joseph Henry, physicist; Spencer Fullerton Baird, biologist; Samuel Pierpont Langley, astronomer and physicist; and Charles Doolittle Walcott, geologist and paleontologist—their names will long remain as outstanding leaders in the annals of science.

Joseph Henry

When the newly organized Board of Regents of the Smithsonian, shortly after their first meeting in 1846, called Joseph Henry to be the first Secretary, it necessitated a momentous decision on his part. For twenty years he had devoted his life to the work he loved—scientific research; his reputation was already great and growing daily; his surroundings were congenial and his mind was undisturbed as to the future. If he accepted the Smithsonian offer, he must largely give up his research work for administrative duties, surrendering to others the

intellectual rewards of his years of research; and moreover, the organization of a new institution such as the Smithsonian presented many difficult and perplexing problems which did not give promise of a serene life. In the face of these considerations, however, Henry's high sense of duty decided the matter, and he promptly accepted the offer of the Secretaryship.

Joseph Henry was born December 17, 1799, at Albany, New York. He was of Scotch descent, his grandparents having come to America from Scotland in 1775, during the early days of the Revolution. Strange to say, in his early years, Henry appeared to be a very idle boy, caring for little except reading and dreaming. As time went by, he did not seem to be attracted to any occupation, except that during a visit to relatives in Albany he became interested in theatricals. He organized a theatrical troupe among the young people, and furnished them with a translation of a French play which was performed under his direction. This early experience, which seemed of little use at the time, was doubtless one of the causes of his later proficiency in public speaking and in presiding.

Not until 1815, however, did young Henry discover his real interest in life. By a fortunate chance there came into his hands a book entitled "Lectures on Experimental Philosophy, Astronomy, and Chemistry, intended chiefly for the use of Young Persons," published by the Reverend George Gregory in London. This book, which definitely marked the beginning of his great career by showing him the marvels of science and nature, was carefully preserved by his family, and on a blank leaf there is written in Henry's handwriting:

"This book, although by no means a profound work, has, under Providence, exerted a remarkable influence on my life. It accidentally fell into my hands when I was about sixteen years old, and was the first book I ever read with attention. It opened to me a new world of thought and enjoyment; invested things before almost unnoticed

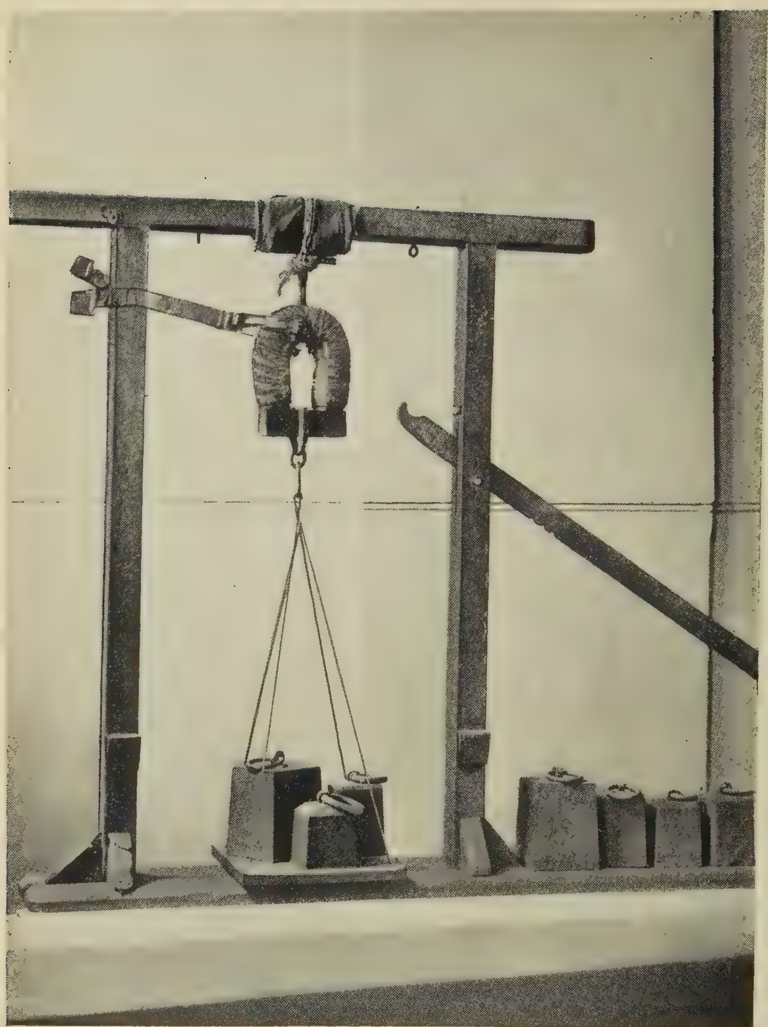
with the highest interest; fixed my mind on the study of nature, and caused me to resolve at the time of reading it that I would immediately commence to devote my life to the acquisition of knowledge."

This resolve was carried out, and he at once entered in earnest upon a career. He first attended night school, and later the Albany Academy, first as a pupil, then as a teacher. Following this, he was occupied in turn as a medical student, a private tutor, and a surveyor. With his appointment as professor of mathematics at Albany Academy in 1825 began his real career as a research worker, and within a few years his advanced investigations won for him the professorship of natural philosophy in the College of New Jersey, at Princeton, where for fourteen years he continued his brilliant research work and successful teaching.

Entering upon his career in the early years of the nineteenth century—a century which will probably always stand among the foremost in the realm of electrical research—he soon came to the fore among the world's physicists. His first great discovery, which would of itself be sufficient to insure his lasting fame, was that of the law of electromagnetic induction, that law upon which is based the entire structure of electrical science. This discovery was made by Henry in America at practically the same time as by Faraday in England, and entirely independently of that great physicist.

Henry's researches at this time with the electromagnet laid the foundations upon which were later built the telegraph and telephone. Before his researches, the most powerful electromagnet which had been constructed could raise only nine pounds, though actuated by a 125-plate battery. Henry's brilliant experiments soon increased this weight, using only a 2-plate battery, to thirty-nine pounds. This was again increased the following year to 750 pounds, in 1831 to 2,300 pounds, and finally in 1834 to 3,500 pounds.

Joseph Henry, 1797–1878, leading American physicist and first Secretary of the Smithsonian Institution



A historic electromagnet, being one of the first ones made by Joseph Henry. Now in the National Museum

Henry's attitude regarding the practical uses of his discoveries is clearly shown by his answer to the question, why he did not patent his application of the electromagnet to the telegraph. "I thought it unbecoming the dignity of true science," he said, "to curtail the use of discovery to personal and selfish uses; on the contrary, I thought it right to give it to the world as a means of advancing humanity." Henry's relation to the principles of the magnetic telegraph is emphatically stated by Doctor Dickerson in these words:

"Upon that apparatus there are but four names to be written. Oersted, who discovered the effect of the voltaic current upon the magnetic needle; Arago, who discovered that the voltaic current could generate magnetism; Sturgeon, who produced the first electromagnet; and Henry, who discovered the conditions under which an electromagnet might be operated at a distance—who invented the devices by which it could so operate—and who applied these devices to an operative telegraph, of the same form and substance as that now in use all over the world."

Perhaps his next most important discovery was that of the oscillatory nature of the electrical current from a Leyden jar, which soon led to great advances in electrical theory. In some of his experiments, discharges from the Leyden jars were transmitted considerable distances without wires, and this perhaps constitutes the first use of the ether as a medium of transmission of electrical waves, today so universally known as radio. In fact, it is stated that Henry, in one of his lectures, said that he regarded even the best copper wire as an impediment in the transmission of electricity. He did not know how to dispense with the wire to get results, but he thought his students would live to see the day of wireless telegraphy.

With Henry's acceptance of the Secretaryship of the Smithsonian, his personal experimental research work practically ceased, and he devoted the remainder of his

life to the broader field of forming and building up this new agency for the increase and diffusion of knowledge among men. A few days after his election, the Board of Regents formally adopted his "Plan of Organization" for the Smithsonian, and this plan determined the whole future course of the Institution. He showed that the "increase" of knowledge should be effected through original research of the highest character, with no restriction as to the kind of knowledge to be acquired, and that the "diffusion" of this knowledge should be accomplished through the publication of a series of memoirs. He dwelt strongly on cooperativeness, and the occupation of neglected fields, avoiding wasteful competition with other scientific agencies. He also provided in his program for the gathering and preservation of natural history and art objects, the development of a library and lecture courses, and the inauguration of a widespread system of meteorological observations.

Under Henry's able and vigorous administration along the lines laid down by him, the Smithsonian's reputation and influence steadily spread throughout the earth. He was called upon by the Government to serve on various commissions, among them the U. S. Lighthouse Board. For six years he was the chairman of the Board, and his researches during these years in fog signaling and on illuminants for use in lighthouses are now famous. In fact, it is generally recognized that to him is largely due the high efficiency of our national system of lighthouses.

Perhaps his best-known work during the years at the Smithsonian was the organization of a meteorological service which later developed into the present Weather Bureau, and which is discussed in another chapter. During the Civil War, Henry was appointed a member of a commission "to examine and report upon various investigations and experiments intended to facilitate the operations of war and to improve the art of navigation."

Many of these researches were carried on in the Smithsonian building, and regarding them, there is an amusing story, for the authenticity of which I cannot vouch:

A certain patriotic citizen of Washington obtained an appointment with President Lincoln one evening at the White House and on entering his presence declared with solemn mien:

"Mr. Lincoln, there is a traitor to our Union right here in Washington, and what is worse, he is a man of high and trusted office."

"How do you know this?" asked Mr. Lincoln.

Walking to the south window of the room, the caller pulled aside the curtain and pointed toward the north tower of the Smithsonian building.

"See for yourself, sir. Every evening after dark, lights of a suspicious character are displayed on that tower, and there can be no explanation in these times but that the Secretary of the Smithsonian Institution is a traitor to his country!"

Mr. Lincoln looked at the light on the tower for a moment and then broke into a hearty laugh. "Do not worry any longer, my friend," he said, "Professor Henry himself called on me today and we discussed for some time the value of those very lights for signaling purposes. Far from being a traitor, he is working day and night to give us better methods of signaling for the use of our own forces."

From this war-time commission grew the National Academy of Sciences, with Henry as its second president, which more recently performed such valuable services to the Government during the period of World War I.

The name of Joseph Henry has been perpetuated in many ways. By order of Congress, his statue in bronze by the American sculptor, W. W. Story, has been erected in the Smithsonian Park; the term "henry" was adopted in 1893 by the International Congress of Electricians as the standard unit of inductive resistance; and in recog-

nition of his aid and encouragement of the early Government surveys of the West, his name was given to a magnificent range of mountains in the region covered by the explorations. In May, 1924, a bust of Joseph Henry was installed in the Hall of Fame at New York University, and in concluding the address at the unveiling, Mr. Frank B. Jewett said:

"Certainly no one of our countrymen is more deserving of a place in this Hall of Fame than Joseph Henry. While the details of his life and work are perhaps not widely known, the results of his researches are of the most enduring character and for all time must enter intimately into the lives of all civilized mankind. Henry was perhaps the foremost of American physicists. And it is well attested by every record that he was a man of varied culture, of great breadth and liberality of views, of generous impulses, of great gentleness and courtesy of manner combined with equal firmness of purpose and energy of action. He was in every way, and in the best that the word denotes, a scientist, and when he died in 1878, almost the last words which passed his lips were to inquire whether the transit of the planet Mercury had been successfully observed."

Spencer Fullerton Baird

As eminent as Henry, though in a quite different field of science, was the next Secretary of the Smithsonian—Spencer Fullerton Baird, who was, with Agassiz, the leading American biologist of his time. A large man of splendid physique, one of Baird's outstanding characteristics was his calmness and even temper. It is said that only twice in his life did he display anger, once in his youth when his favorite dog was abused by someone, and again at the Smithsonian when one of the clerks as a matter of routine opened and read a personal letter from his aged mother. His patience and good nature were equaled,

however, by his enthusiasm for scientific research and by his unlimited capacity for work. As an instance of the almost incredible rapidity with which he turned out his now famous writings, he began his classic work on birds in August, 1857, and although able to devote to it only such time as he could spare from pressing administrative duties, he completed it in July, 1858, having written in these eleven months the equivalent of more than 1,000 quarto pages of technical manuscript.

Baird was born in Reading, Pennsylvania, on February 23, 1823, and at the age of ten years, his father having died, he moved with his mother to Carlisle, Pennsylvania, where was located Dickinson College. Baird's interest in natural history began when he was still a boy, and he and his brother William collected birds and other specimens in the vicinity of Carlisle when he was but fourteen years old. Many of these very specimens, as well as the larger and more important collections which he acquired later and which occupied two freight cars when shipped to Washington, are still preserved in the National Museum. After his graduation from Dickinson College at the age of seventeen, being still too young to enter any profession, Baird had some years at his own disposal. These he used to excellent advantage, studying medicine on his own initiative, and undertaking long trips to collect natural history specimens for his "museum" and to visit the collections in various cities.

Many of these expeditions were made on foot, and he accomplished some remarkable feats in long-distance walking. In 1841, the year after his graduation, he covered 420 miles on foot in twenty-one days, walking sixty miles on the last day. During the next year, his walking excursions covered the remarkable total of 2,100 miles. One night, after walking ten miles carrying a load weighing forty pounds, he measured himself and found his height to be five feet, eleven and one-fourth inches. In the morning, after a full night's rest, he measured full six

feet, demonstrating that the long walk with a heavy pack had compressed his stature by three-quarters of an inch.

In 1846 he was made professor of natural history and chemistry in Dickinson College, where he remained for four years, continuing his collecting expeditions as he was able to find time. Here he married Miss Mary H. Churchill, declaring that he fell in love with her because of the excellent labels she prepared for his specimens.

During his teaching career, Baird supplemented classroom instruction in natural history with field trips and laboratory experiments. On these expeditions he knew how to show the students who accompanied him the fascinating features of the various phenomena encountered, and his enthusiasm proved so contagious that his pupils followed him uncomplainingly for as much as twenty or thirty miles over the countryside in a day. Once when entomology was the order of the day and the students were busily engaged in chasing various insects, their antics looked suspicious to a group of simple German farmers working nearby, and they proceeded to surround and capture the young entomologists, and believing them to be escaped lunatics, proposed to return them to an asylum.

Young Baird became acquainted with Secretary Henry of the Smithsonian in 1848 during a visit to Washington, and in 1850 he accepted the position of Assistant Secretary of the Institution, thus entering upon his life work. A full account of this work would require a volume in itself, for Baird was the very personification of systematic industry. He never wasted time through misdirected effort, and he was able to carry on his scientific writing during days crowded with diverse administrative duties by his ability to pick up the continuity of his manuscript during every brief interval. He himself said that he wrote his famous monograph on the birds of North America in disconnected periods averaging not over fifteen minutes each.

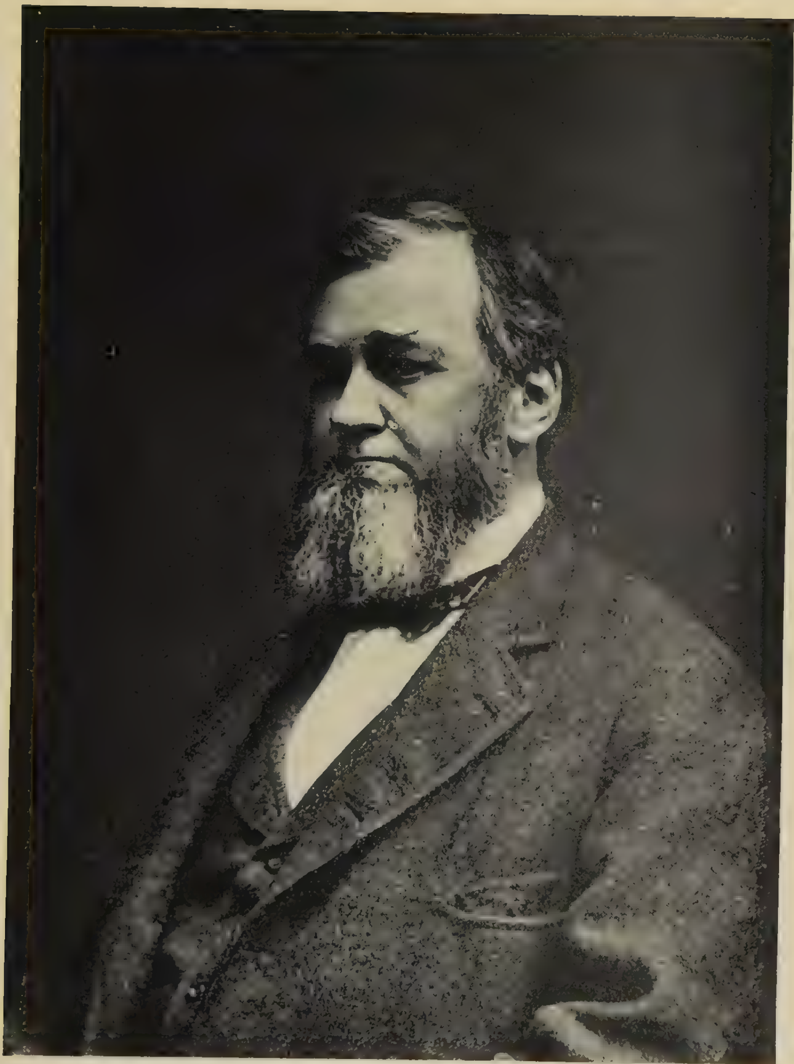
A list of Baird's writings during his thirty-seven years at the Smithsonian contains more than a thousand titles. While, of course, the majority of these were reviews and short notices, nevertheless more than two hundred constitute real scientific contributions, and certain of his major writings have become classics. He is best known for his ornithological works, although his scientific activity was by no means confined to the study of birds. His publications on the mammals, reptiles, and fishes of North America are equal in scope and standing to the bird volumes; in fact, he was one of the last of the school of "all-around" naturalists, a species which in these days of ultra-specialization is almost if not quite extinct.

Baird's "Birds of North America," is a quarto monograph of over a thousand pages. This book was for many years the outstanding reference work on ornithology, and even today it is considered indispensable by all students of bird life. Of equal importance to this bird volume was that on the mammals of North America, which also remained the standard in this field for many decades. Regarding this work, one of the greatest American mammalogists has said that if he had Baird's description of a species, he would not consider it necessary to see a specimen of that species, and this was something that could not be said about any other writer in that field. Baird's "North American Serpents" and his other published papers on American reptiles occupied nearly the same position for the science of herpetology as did his other works for ornithology and mammalogy. In ichthyology, he published the life histories of two species of importance from an economic standpoint, the bluefish and the scuppaug. These marked the beginning of a new method of presenting the life histories of the various species, as they were by far the most comprehensive yet attempted. Baird described not only the range, habits, migrations, reproduction, and growth of the species, but considered also the equally important questions of food, temperature, enemies,

economic value to man, most effective and least wasteful methods of capture, and other practical matters. These comprehensive monographs on individual species, particularly those of commercial value, were not only of great usefulness in themselves, but they served as models for the younger men who worked with Baird and those who followed him.

This remarkable versatility, which was Baird's outstanding characteristic, stood him in good stead in developing the National Museum of the Smithsonian. The great collections made by the Wilkes Exploring Expedition, which legally formed the beginnings of the National Museum, were not turned over to the Smithsonian until 1857, when Congress provided a small appropriation for their care. The Baird collection, therefore, which arrived in 1850, when the only other specimens at the Institution were a few cases of plants and minerals, formed the real nucleus of what is now, in many respects, the greatest organization of its kind in the world—the United States National Museum. Baird put into effect the same methods of administration and development which he had worked out for his little museum at Carlisle, and their efficiency is attested by the enormous and well-rounded growth of the National Museum under Baird's guidance.

Another of Baird's duties as Assistant Secretary was the supervision of the exploration work of the Institution. It was just at the time of his coming to Washington that great activity in exploration of the West began. The Institution was the custodian of the great mass of collections gathered by these exploring parties in the years that followed, and the naturalists who sent in the material later assembled at the Institution to carry on the necessary studies connected with it. Baird was at this time in his element, planning outfits and providing instructions for explorers, and, more important, inspiring them with his own enthusiasm for the work. The published reports



Spencer Fullerton Baird, 1823-1887, second Secretary of the Smithsonian Institution, organizer of the National Museum and the U. S. Bureau of Fisheries

of these early surveys were prepared for the most part with his cooperation and supervision. His connection with the official explorations was, however, only a part of the work; he was in close touch with a small army of private collectors, who obtained through his cooperation outfits, instructions, and unbounded enthusiasm.

During the decade of the Civil War, Baird conducted expeditions each summer which were devoted more and more to the study of fishes and other forms of aquatic life, until in 1871 there was organized the Fish Commission, with Baird as the first Commissioner. While he did not permit this work to interfere with his Smithsonian duties, nevertheless it held great interest for him, and he devoted a large share of his time and thought to it for the rest of his life. The office of Commissioner of Fish and Fisheries had been created for him, since the law establishing the Commission stated that the Commissioner should be a "civil officer of the Government, of proved scientific and practical acquaintance with the fishes of the coast." Baird was one of only two men in America at that time who could fill these requirements, and the other would not have allowed himself to be considered a rival of Baird.

With the death of Professor Henry in 1878, Baird was unanimously chosen his successor as Secretary of the Smithsonian. He carried on Henry's purpose vigorously and with increased attention to exploration and to the building up of the library. As Assistant Secretary he had developed the system of international exchange of publications, and this he advanced notably as Secretary. He advocated and supervised the erection of a building for the rapidly growing National Museum, and was instrumental in securing from Congress authorization to increase the permanent fund of the Institution on deposit in the Treasury of the United States to one million dollars.

Baird's duties, ever strenuous at the Smithsonian, became even heavier after his appointment as Secretary,

and suffering from an aggravation of the heart trouble to which he had been subject for many years, his overtaxed strength refused to carry him farther, and he was forced to yield in 1887. In August of that year, he died at the biological station at Woods Hole, where he had desired to spend his last days.

In summarizing Baird's influence on American science, his associate, Dr. G. Brown Goode, said:

"No name occupies a more honorable place in the annals of American science than that of Professor Baird. His personal contributions to systematic biology were of great extent. His influence in inspiring and training men to enter the field of natural history was very potent. As an organizer, working at a most fortunate time, he knew how to utilize his extraordinary opportunities, and he has left his impress forever fixed upon the scientific and educational institutions of the United States, more especially upon those under Government control."

Samuel Pierpont Langley

When Secretary Baird's health broke early in 1887, as a result of many years of continual overwork, he realized that he could not go on much longer, and advised the Board of Regents to secure the services of a competent Assistant Secretary who would be ready to take his place. Acting on this advice, the Regents offered the position, with the unwritten understanding of succession to the Secretaryship, to Samuel Pierpont Langley, at that time already of wide repute as an astronomer and physicist.

In the public mind, the name of Langley is associated only with his pioneer work in aviation. To those who know the story of his life and work, his name is associated with many other researches, even more fundamental than those connected with the art of flying. These relate to his study of the sun, in the course of which he succeeded in increasing the known length of the solar spectrum to eight times that which was known to Sir Isaac Newton;

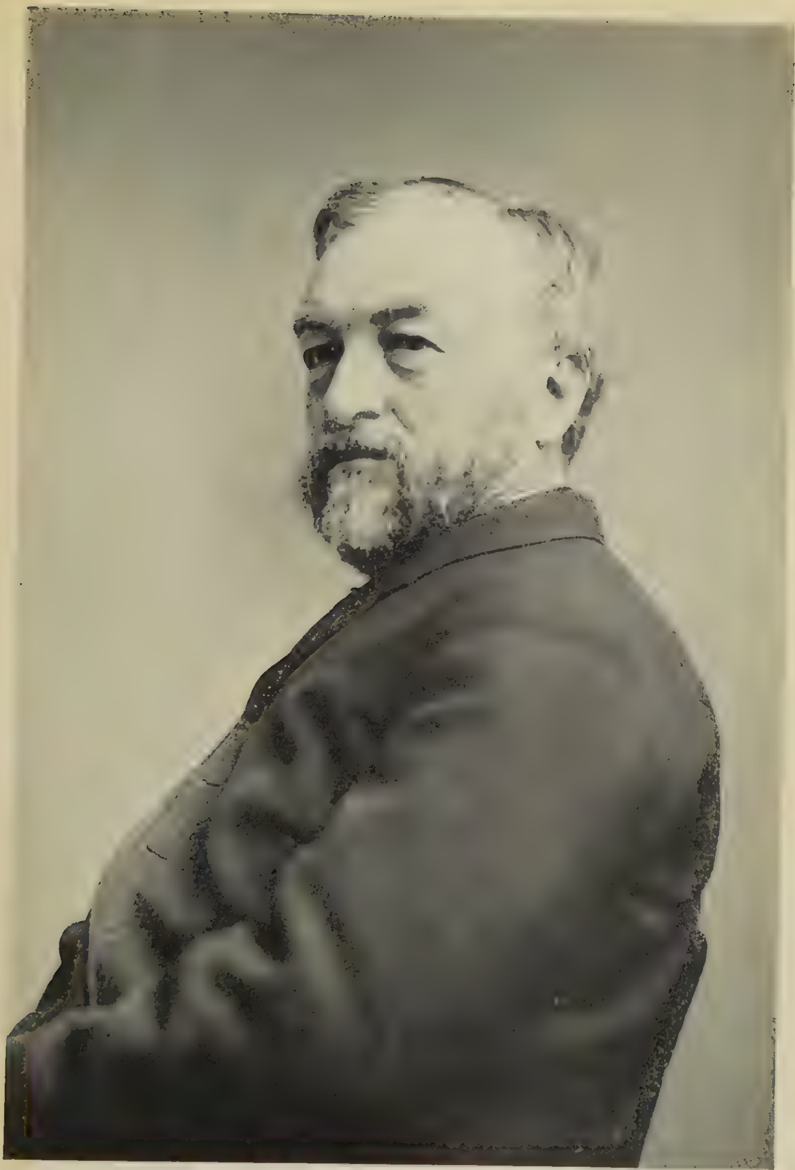
in contributing largely to the existing knowledge of the solar disk, of sun spots, and of the absorbing power on the sun's rays of our atmosphere; and in first publishing the important observation that the heat coming to us from the sun, as it would be measured outside of and thus free from the complications added by the atmosphere, is not constant as formerly supposed, but shows decided variations which are of sufficient magnitude to be of meteorological importance.

Langley was born in Roxbury, Massachusetts, August 22, 1834. He attended grammar school and high school in Boston, but was not sent to college. The early tendency of his mind is well shown in the following reminiscences of his later life:

"I cannot remember when I was not interested in astronomy. I remember reading books upon the subject as early as at nine, and when I was quite a boy I learned how to make little telescopes, and studied the stars through them. Later I made some larger ones, and though they were, of course, nothing like those we use here, I think myself they were very good for a boy. One of the most wonderful things to me was the sun and how it heated the earth. I used to hold my hands up to it and wonder how the rays made them warm, and where the heat came from and how. I asked many questions, but I could get no satisfactory replies, and some of these childish questions have occupied many years of my later life in answering. I remember, for instance, one of the wonders to me was a common hotbed. I could not see how the glass kept it warm while all around was cold, and when I asked, I was told that 'of course' the glass kept in the heat; but though my elders saw no difficulty about it, I could not see why, if the heat went in through the glass, it could not come out again. Since then I have spent many years in studying the way that that great hotbed, the earth itself, on which we live, is, by a like principle, made warmer by the atmosphere that covers it."

In the years of Langley's youth, astronomy was not considered to offer a career, and so he decided that the next best occupation for him was civil engineering. This was soon modified to architecture, and after a few years in this profession, not very profitable because of a financial panic and succeeding business depression, he learned that the Cambridge observatory was being reorganized. Upon presenting himself to Professor Winlock, director of the observatory, he was at once accepted as an assistant, and at the age of thirty his youthful ambition was realized—he was to be an astronomer.

From this auspicious beginning in his life work, Langley's rise was rapid. From boyhood he had read all the astronomical books that he could find, and he had already constructed with his own hands several telescopes, the last of which was an effective instrument of seven-inch aperture. From the researches of the following ten years, he was recognized as one of the most brilliant and original astronomers of his time. From Cambridge he went in 1866 to Annapolis as assistant professor of mathematics in the Naval Academy, where he promptly put into shape for practical work the Academy's observatory, which had been abandoned during the Civil War. The following year he accepted the offer of the directorship of the Allegheny Observatory, which carried with it the professorship of astronomy and physics at Western University of Pennsylvania. Here he remained for twenty years, and here were conducted his brilliant researches on the solar disk, the solar atmosphere, the distribution of the heat of the solar surface, and most notable of all his investigations of the solar spectrum. This work brought him such a wide reputation as an astronomer and physicist that in 1887 Langley was called by the Smithsonian Regents to the position of Assistant Secretary of the Institution, and upon Baird's death later in the same year, he was made Secretary, in which position he remained for the rest of his life. His outstanding achievements



Samuel Pierpont Langley, 1834–1906, third Secretary of the Smithsonian Institution, astronomer, physicist, and pioneer in the establishment of the principles of mechanical flight

Langley's 14-foot model aerodrome with steam engine in flight without a pilot over the Potomac River, May 6, 1896. It flew three-fifths of a mile in the first of two successful flights made on that day. Photograph by Alexander Graham Bell

in the field of science during this later period were the discovery of the variability of the sun's radiation and his epoch-making researches in aeronautics.

One of the most important results of Langley's study of flight was rescuing from ridicule this world-old subject of speculation and elevating it to the rank of a true scientific investigation. Regarding this aspect of the subject, Mr. Octave Chanute wrote in 1896:

"It is significant, however, that, prior to the publication of Doctor Langley's work, it was the rare exception to find engineers and scientists of recognized ability who would fully admit the *possibility* of man being able to solve the twenty-century old problem of aviation. Professor Joseph Le Conte, in the *Popular Science Monthly* of November, 1888, has recently taken the ground, flatly, 'that a pure flying machine is impossible.' This was probably based on the fact that the then accepted formula of Newton and the calculation of Napier and other scientists, if correct, rendered the solution practically impossible. Since the publication of 'Experiments in Aerodynamics,' however, it is the exception to find an intelligent engineer who disputes the *probability* of the eventual solution of the problem of man-flight. Such has been the change in five years. Incredulity has given way, interest has been aroused in the scientific question, a sound basis has been furnished for experiment, and practical results are being evolved by many workers. Much remains to be discovered concerning curved surfaces, with which alone practical flight is likely to be achieved, but when this is accomplished it is probable, in my judgment, that the beginning of the solution will be acknowledged to date back to the publication of Doctor Langley's book, and that he will be as distinguished as Secretary Henry is now with regard to the development of electrical appliances."

Langley's interest in the problem of flight began as a boy, when he used to watch with absorbing interest the

wonderful soaring flight of hawks and buzzards. In later years he attacked the problem from this same angle, and attempted to discover what properties of the air enabled the soaring birds to rise and fall, sail up and down the wind, and turn in large circles, all with no flapping of the wings and little apparent effort. The results of several years of his original experiments and theoretical study were published in two quarto monographs with the titles "Internal Work of the Wind," and "Experiments in Aerodynamics." Having completed this fundamental work, Langley turned his attention to the construction of model "aerodromes" as he called them, to test the application of his conclusions. His first small model airplanes were driven by propellers actuated by powerful rubber bands, and these little planes were tested in the Smithsonian grounds. It is said that it was a very amusing sight to behold the dignified Secretary of the Smithsonian Institution rushing about with coat-tails flying, chasing and dodging the little toy planes. Beginning in 1891, in the next four years he constructed four model "aerodromes." These models, with a wing spread of from 12 to 14 feet, were powered with steam engines, and were as carefully constructed in every detail as though they were intended to carry a pilot.

After several unsuccessful trial flights, each of which taught its lesson, Aerodrome No. 5 was again ready for trial on May 6, 1896. Langley and his associates, together with camera men and workmen proceeded down the Potomac to a quiet bay near Quantico, where the aerodrome was to be tested. The little plane was to be launched into the air from the top of a specially constructed houseboat, and when the launching device was set and everything adjusted, the signal was given. It was a thrilling moment. The aerodrome shot from the top of the houseboat, sailed a short distance on level wing, and gradually rose higher and higher in a beautiful, graceful flight of about 3,000 feet, well over half a mile, when

its fuel gave out and it settled on the water. It is hard for us now to realize what an inspiring sight this was to the eager watchers, and most of all to Langley himself, to thus see a steam engine flying in the air with wings like a bird, completely substantiating Langley's years of research on the problem of mechanical flight.

Several other flights were later made with this and other models, and with an allotment from the War Department he began the construction of a full-size man-carrying aerodrome. In 1903 two attempts were made to fly this machine, with Charles M. Manly in the pilot's seat, but each time, due to defective operation of the launching device, the plane fell into the water without getting fairly in the air. Regarding these trials, the late Dr. Alexander Graham Bell, who himself was keenly interested in the work and witnessed most of the flights, said in 1910 on the occasion of the first presentation of the Langley Medal to the Wright brothers:

"The public, not knowing the nature of the defect which prevented the aerodrome from taking the air, received the impression that the machine itself was a failure and could not fly.

"This conclusion was not warranted by the facts; and to me and to others who have examined the apparatus, it seems to be a perfectly good flying machine—excellently constructed and the fruit of years of labor. It was simply never launched into the air, and so has never had the opportunity of showing what it could do. Who can say what a third trial might have demonstrated? The general ridicule, however, with which the first two failures were received prevented any further allotment of money to give it another trial.

"Langley never recovered from his disappointment. He was humiliated by the ridicule with which his efforts had been received, and had, shortly afterwards, a stroke of paralysis.

"He had some consolation, however, at the end. Upon

his deathbed he received the resolution of the newly formed 'Aero Club of America,' conveying the sympathy of the members and their high appreciation of his work.

"Langley's faith never wavered, but he never saw a man-carrying aerodrome in the air.

"His greatest achievements in practical aerodromics consisted in the successful construction of power-driven models which actually flew. With their construction he thought that he had finished his work; and, in 1897, in announcing the supposed conclusion of his labors he said:

" 'I have brought to a close the portion of the work which seemed to be specially mine—the demonstration of the practicability of mechanical flight—and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others.' "

Under Secretary Langley, the International Exchange Service and the Smithsonian library were greatly expanded; the funds of the Institution were increased through gifts and bequests very nearly to the limit of one million dollars which by law might be deposited in the Treasury of the United States, and Langley succeeded in prevailing upon Congress to authorize the Institution to accept and administer such funds in excess of this amount as might be received. Two branches of the Institution were founded solely through Langley's efforts —the Astrophysical Observatory and the National Zoological Park. His scientific achievements, however, constitute his greatest service to the Smithsonian, since both his name and that of the Institution of which he was the head will always be associated in the memory of man with Langley's pioneer work in aeronautics and his epoch-making researches on the sun.

Since Langley's death, his work in aeronautics has been recognized in many ways; the Langley Medal was established by the Smithsonian, to be presented for achieve-

The former Children's Room in the Smithsonian Building, which Secretary Langley created

ments in aeronautical science and its application, the first great airplane carrier constructed by the U. S. Navy was named the *Langley*; and one of the largest Army flying fields, situated near Hampton, Virginia, bears the name "Langley Field."

Charles Doolittle Walcott

Of the fourth Secretary of the Institution, Dr. Charles Doolittle Walcott, it has been well said that he was always a geologist, for at the early age of thirteen he was already engaged in making systematic collections of fossils and minerals, and at seventeen he had planned to devote his life to a study of the older fossiliferous rocks of North America, known as the Cambrian. Until his death at nearly seventy-seven years of age, he followed this plan. Doctor Walcott's discoveries during fifty years on these ancient rock formations and the fossil forms preserved in them are said to represent seventy per cent of the world's knowledge of these subjects. Seldom indeed is it that youthful plans and resolves are thus faithfully carried out during a long lifetime.

When Secretary Langley died in 1906, and it became necessary for the Board of Regents to select his successor, the choice naturally fell upon Doctor Walcott, since, besides his wide reputation as a scientist and his established success as an administrator, he had for many years been a curator in the department of geology of the National Museum, and upon Doctor Goode's death in 1897, he had been placed in charge of the Museum for a short period. Doctor Walcott accepted the appointment as Secretary, entering upon his duties in 1907. From that time, in addition to advancing and expanding the activities of the Institution and its branches, he utilized every spare moment to pursue his geological researches, causing Doctor Harker, ex-President of the British Geological Society to say, in presenting him with the coveted Wol-

laston Medal, that "his personal researches have excited interest and admiration wherever geology is cultivated."

Of New England ancestry, Doctor Walcott was born in New York Mills, New York, March 31, 1850. He was educated in the public schools of Utica, New York, and in the Utica Academy. After leaving the Academy he was employed in a hardware store for a period of two years, during which time he acquired practical business experience which was of value in later life. During these early years, he became interested in collecting rock specimens and in studying the fossils which he occasionally discovered in them. One winter he met the well-known geologist, Colonel Jewett, who by providing him books and suggestions for further study stimulated this interest, and his reading and collecting were continued. In 1871 he went to Indianapolis, where he was offered an excellent opening in the field of business, and it was evident that he must decide at this time whether science or business was to be his life work. With little hesitation, he chose science, and in order to have opportunity to continue his geological studies, he returned to New York State and accepted work on a farm under an arrangement which left him a certain proportion of his time free for collecting and study. This arrangement was continued for five years, during which time he succeeded in making a large collection of the fossils of the region.

In 1876 his serious work began, and under an appointment as assistant to the State Geologist of New York State, he conducted geological researches in several states and in Canada. After three years in this position he received an appointment in the U. S. Geological Survey as field assistant, and his first work for the Survey was a study of the great series of formations exposed by the Grand Canyon of the Colorado. Following the successful termination of this work, he was assigned to a study of the Eureka Mining District and other sections of Nevada. Shortly after this he was put in charge of a division of

the paleontological work of the Survey and from this time forward his rise was rapid. He was appointed paleontologist in charge of invertebrate paleontolgy in 1888, and three years later was promoted to chief paleontologist. In 1893 he was made geologist in charge of geology and paleontology, and upon the retirement of Major Powell in 1894, Doctor Walcott was chosen by the President as the next Director.

During his years with the Survey, he was able to devote much work to the advancement of his chosen research—the study of the older rocks of America. In the East, he examined the Cambrian formations throughout the Appalachian belt, from Alabama in the South to Quebec in the North, and again in an easterly direction from New England through New Brunswick to Newfoundland. In the West, he studied all of the known important Cambrian and pre-Cambrian localities, including those of Idaho, Nevada, Montana, Wyoming, South Dakota, California, Arizona, and Texas. From all of these expeditions, he brought back large collections of the representative fossils of these ancient formations, and through his skillful and painstaking identification and description of the fossils, much was added to the knowledge of the early forms of life on the earth. Regarding these investigations and their results, Doctor Walcott has written:

"Few of us have a clear realization of the age of the earth. Under many deceptive aspects she carries with her the secrets of a long and busy life, one of such fascinating activity that it is not surprising that students are ever seeking to unravel the mysteries of the past. With all the evidences of youth there is to be felt, especially among the mountains, a sense of age and infinite power, and we are inspired with awe as we trace the base of worn-down rocks, miles in thickness, that formed the mountain ranges far back in geologic time. . . .

"A concrete conception of the age of life on the earth is suggested by recalling that the Cambrian system, with

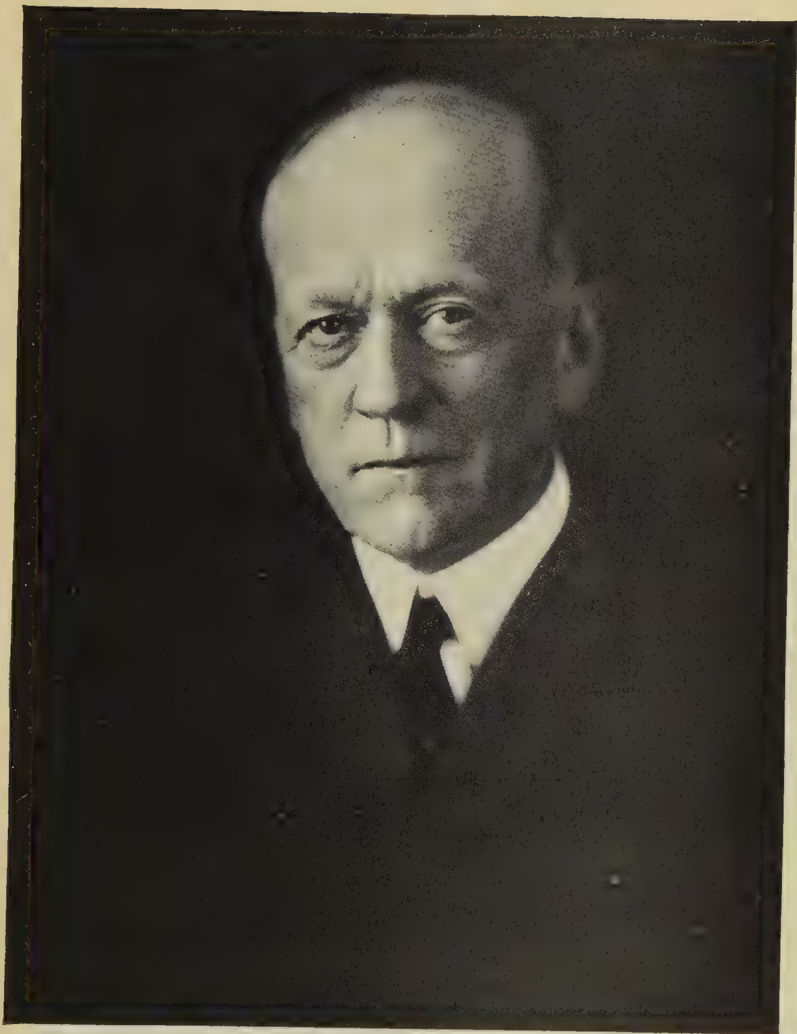
its early and semiprimitive forms of invertebrate marine fossils, stands, roughly speaking, midway in the earth's history; approximately as long a period of time was required to develop life to the Cambrian stage of evolution as has since elapsed up to the present time.

"My own investigations have been mainly in the Cambrian and pre-Cambrian strata and have involved new and somewhat startling discoveries that helped to show how very much earlier life was developed on our planet than we had previously supposed. These researches have taken into consideration the records left on all the continents and many of the great islands. . . .

"Field work, with compass, hammer, and chisel, has been the rule, followed by laboratory and critical comparison of many thousands of specimens of fossil genera and species of ancient marine life, and often study of microscopic sections of rocks and fossils in the hope of finding evidence of the presence of minute and active bacterial and simple algal workers, such as exist in modern seas and lakes, which by their united efforts form great masses of the recent sea and lake deposits."

Early in his public career, Doctor Walcott became deeply interested in the conservation of America's natural resources, and in spite of his strenuous duties with the Geological Survey, he found time to actively promote the first attempts to conserve our rapidly diminishing forests. To this end he succeeded in 1898 in securing the passage of an amendment to the Survey appropriation bill, providing for the organization of a forestry service. In 1902 he became interested in the important matter of reclaiming by irrigation the vast extent of arid lands in the West, and directly through his efforts in this connection during the next five years there was organized the U. S. Reclamation Service which has since done so much to increase the extent of available agricultural lands in the West.

During his incumbency as Secretary of the Smithsonian, Doctor Walcott still continued to carry on his life



Charles Doolittle Walcott, 1850–1927, fourth Secretary of the Smithsonian Institution, geologist and paleontologist who led in the study of the earliest recorded forms of life

PLATE 99

Secretary Walcott (right) at the famous fossil quarry on Mount Wapta in the Canadian Rockies, where thousands of well-preserved marine creatures were discovered in the Middle Cambrian rocks

work—the study of the older rock formations. Every summer season he spent in the Canadian Rockies studying the Cambrian and pre-Cambrian formations, and from this field work were accumulated vast collections of fossils which he studied and described during the winter months. The published results of these geological and paleontological researches have won recognition from scientists of every nation.

During his administration of the Smithsonian, the beautiful building for the natural history department of the U. S. National Museum was completed and opened to the public, and the former National Gallery of Art (now the National Collection of Fine Arts), and the Freer Gallery of Art became active administrative units under the Institution, bringing the number of bureaus under its direction up to eight.

Doctor Walcott held many important scientific posts in the United States, including the presidency of the National Academy of Sciences and of the American Association for the Advancement of Science. He held a long list of degrees from American and European universities and colleges, and was a member of scientific societies and academies of nearly every country.

During World War I, Doctor Walcott rendered notable service in an administrative capacity, and he was instrumental in organizing the National Advisory Committee for Aeronautics, of which he remained a member until his death, the latter part of the time as its chairman.

Of the reasons for his success in life, an account which appeared a few years ago in the *Geological Magazine* of England says:

"Dr. Walcott has been favored by fortune in many ways. A short acquaintance with him suffices to reveal some of the causes which have contributed to his success. His commanding figure is an indication of exceptional energy and physical strength, and on seeing him one is not surprised that at a ripe age he is able to carry out

his field work under arduous conditions. His unwearied industry also strikes one at once, for no opportunity for work is lost. The powers of specialization and generalization are equally developed with him; while missing no feature in the minute anatomy of some organism, he is able 'to think in continents' and has thus contributed largely to the elucidation of physiographical problems connected with Paleozoic times. He can turn at will from one task to another. The onerous duties of administrative work in no wise check the enthusiasm with which he enters into his field labors."

The Honorable R. Walton Moore, a Regent of the Institution, wrote of him as follows:

"This is Thackeray's description of a gentleman which I have often thought applied very distinctly to Doctor Walcott:

" 'What is it to be a gentleman? It is to have lofty aims; to keep your honor virgin; to have the esteem of your fellow citizens and the love of your fireside; to bear good fortune meekly; to suffer evil with constancy; and through evil or good to maintain truth always. Show me the man whose life exhibits these qualities, and him we will salute as gentleman whatever his rank may be.'

"He had my unstinted admiration and affection and I hope to be able to assist, at least a little, in the effort to maintain his ideals."

CHAPTER XVIII

THE BEGINNINGS OF THE WEATHER BUREAU

In the night of November 14, 1854, a fearful storm arose in the Black Sea. It overwhelmed the fleet of England which was supporting the army besieging the Russian fortress of Sevastopol. About thirty English vessels were wrecked and their indispensable cargoes of medical supplies, forage for animals, and other necessaries were lost. From this disaster followed those frightful sufferings which made the Crimean war a byword of misery and lifted the name of Florence Nightingale into such a white splendor for her work in the British field hospitals.

The ships of the French allies, lying at Kameish Bay were little damaged; but the Emperor Napoleon III, always interested in science, caused inquiry to be made as to whether the coming of the storm might have been predicted. French scientific men soon learned that the path of the storm over Europe was indeed so definite and its violence so evident that if a telegraphic weather service had been organized at that time, sufficient warning would have been given to prevent the dreadful losses. This gave a great impetus to the establishment of government weather bureaus throughout the world.

Indeed it is the electromagnetic telegraph which has made possible those weather forecasts which again and again have saved life and property during the past seventy-five years. Secretary Henry was among the very first

to see these possibilities, and to organize means to realize them by the agency of the Smithsonian Institution. Expressing his keen interest in this useful research, he wrote:

"It has been aptly said that man is a meteorologist by nature. He is placed in such a state of dependence upon the atmospheric elements that to watch their vicissitudes and to endeavor to anticipate their changes become objects of paramount importance. Indeed the interest in this subject is so absolute that the common salutation among civilized nations is a meteorological wish, and the first introduction to conversation among strangers is a meteorological remark."

Professor Henry wrote these words in 1865, after the Smithsonian Institution had for some sixteen years been conducting regular studies and observations of the weather; and yet at the end of this time he still seemed to feel, with Mark Twain, that everybody talks a great deal about the weather, but nobody does anything about it, for his statement continues:

"Yet there is no circumstance which is remembered with so little exactness as the previous condition of the weather, even from week to week. In order that its fluctuations may be preserved as facts of experience, it is necessary that they should be continuously and accurately registered. Again, there is, perhaps, no branch of science relative to which so many observations have been made and so many records accumulated, and yet from which so few general principles have been deduced."

The present U. S. Weather Bureau, maintained by the Government as a part of the Department of Commerce, traces its origin directly to the Smithsonian Institution. It is true that the Army Medical Department recorded weather data as early as 1818, yet the actual forerunner of the Weather Bureau as a distinct and extensive public activity may be found in the early meteorological work of the Smithsonian. The beginning

of this work was practically coincident with the founding of the Institution; for in 1847, the year following its incorporation by Congress, Professor Henry included among the objects which he believed to be suitable for the Institution to undertake, a system of meteorological observations "for solving the problem of American storms." This project he described in his program of organization as follows:

"Of late years, in our country, more additions have been made to meteorology than to any other branch of physical science. Several important generalizations have been arrived at, and definite theories proposed, which now enable us to direct our attention, with scientific precision, to such points of observation as cannot fail to reward us with new and interesting results. It is proposed to organize a system of observation which shall extend as far as possible over the North American continent. The present time appears to be peculiarly auspicious for commencing an enterprise of the proposed kind. The citizens of the United States are now scattered over every part of the southern and western portions of North America, and the extended lines of the telegraph will furnish a ready means of warning the more northern and eastern observers to be on the watch for the first appearance of an advancing storm."

The time and conditions were highly auspicious. Here lay a great country, over 3,000 miles from west to east, over which telegraph lines were beginning to spread their network. Because the spherical earth turns around daily from west to east under the powerful heating rays of the sun, it is a necessary consequence that important storms also travel from west toward east in our latitudes. It requires from three to seven days as a rule for storms to cross the United States. In Henry's time by far the most of the population and business of almost every sort was east of the Mississippi, and even east of Indiana. Hence it was only necessary to receive timely intelligence

of the state of the weather at the western outposts to be forewarned as to the great atmospheric movements apt to endanger the commerce and business of the most populous regions.

With the approval in December, 1847, of Henry's program of organization for the work of the Smithsonian, the first Board of Regents appropriated one thousand dollars for the meteorological feature. In 1848 Professor Espy, at that time meteorologist of the Navy Department, was assigned to collaborate with the Smithsonian, and Professor Henry, with his assistance, set about to organize the work. Through an arrangement with the Surgeon General of the Army, the system of observations regularly made by medical officers of the Army was remodeled to accord with the Smithsonian plan, and the same concession was made by the systems in operation in New York and Pennsylvania. A circular letter was prepared and sent to a list of persons who seemed likely to be interested enough to become volunteer observers, and before a year had passed, the Smithsonian meteorological system included over 150 observers recording weather conditions in their particular localities every day.

From the very beginning every effort was made to standardize the work, so that results in all sections of the country should be equally reliable and comparable. To this end several steps were taken, the most important being the importation from abroad of standard thermometers and barometers, by means of which those made especially for the Smithsonian were standardized before being furnished to the observers. A pamphlet prepared by Professor Guyot, one of the leading American meteorologists, containing "Directions for Meteorological Observations," was issued by the Institution in 1850, and in 1852 there was published a volume of "Meteorological Tables" prepared by the same author. This valuable collection of meteorological data was intended primarily for use by the Smithsonian observers, but it proved to

be so useful to students of the weather everywhere that two revised and enlarged editions were issued within ten years. Later revisions of the tables threatened to become so bulky that they were gradually subdivided into distinct volumes, now known as "Smithsonian Meteorological Tables," "Smithsonian Physical Tables," "Smithsonian Geographical Tables," and "Smithsonian Mathematical Tables."

In 1849 Professor Henry took a step which may be considered the actual germ of the present National Weather Bureau. Realizing the potential value to meteorology of the system of telegraph lines, by that time quite widely extended, he asked the telegraph companies to instruct their operators to open their regular morning communications by indicating the general condition of the weather in their vicinity, instead of signaling "O. K." as was then the custom. The officials of the telegraph companies agreed to this and the reports from the various sections of the country were communicated every day to the Smithsonian. Thus there was established the first system of telegraphic weather reports in the world.

Although the observations of the various telegraph operators were of an elementary and abbreviated nature such as "fair," "cloudy," "rain," etc., nevertheless, taken together, they furnished sufficient data for the preparation in 1850 of the first current weather map, showing every day the actual condition of the weather throughout the country. The map was hung in the Smithsonian building, where it attracted great public attention, and the probable weather changes indicated by the trend of the reports were made known to the public by means of suitable signals displayed on the tower of the Smithsonian. These proved to be of such great interest and usefulness that in 1857 the weather reports and indications were published in the Washington *Star*, a daily newspaper, and this method received such public approval

that the telegraphic reports appeared in the *Star* every day thereafter. Here was the origin of the daily weather reports in newspapers.

The daily weather map was improved in 1856 by the use of colored disks to indicate the state of the weather in various localities. These disks were pinned on the map,[1] a white disk indicating clear; black, rain; gray, cloudy; etc. An arrow was printed on the face of each disk, and by turning the disk, the proper direction of the wind at each station could be indicated. This map was the direct forerunner of the present daily weather charts prepared by the National Weather Bureau, which indicate in great detail the meteorological conditions throughout the country.

The following is a sample of the correspondence of Professor Henry relating to the meteorological observations from distant stations:

"Smithsonian Institution,
"Washington, D. C.
"Oct. 26th, 1860.

"Dear Sir:

"Your letter of the 13th of Aug. was received at the Institution about ten days after date, and would have been immediately acknowledged had I been in the city at the time. I now embrace the first opportunity after my return to thank you for your interesting communication and to assure you we shall be much pleased to receive an account of any observations you may make at your interesting station, relative to meteorological and other phenomena.

"We should be much indebted to you for reports of the weather by means of the telegraph as you propose, and will cheerfully pay any expenses which may be incurred in forwarding the letters to St. Paul.

"We are especially anxious to receive information of remarkable changes in the weather—cold spells, etc.—

since being apprised of their existence at your place, they may be expected in the course of a few days at the East.

"Very respectfully your obedient servant,

(Signed) "JOSEPH HENRY,
"*Secretary.*

"R. Ravenburg,
"Hosp. Steward,
"Fort Ripley, Minn."

By 1860 the mass of data received at the Institution from the steadily increasing number of observers had reached such proportions that it was considered desirable to have the statistics reduced and published. This was accordingly done, the publication necessitating two volumes containing over 2,000 quarto pages of valuable data on temperature, rainfall, barometric pressure, direction of wind, humidity, etc. Even before this the Smithsonian had issued a considerable number of papers on meteorology which had a great influence on progress in this subject. Among the more important of these were Professor Coffin's study of the winds of the Northern Hemisphere; reduction of observations for twenty-eight years by Professor Caswell, at Providence, Rhode Island; for twenty years in Arkansas, by Doctor Smith; in the Arctic seas, by Doctor Kane and Captain McClintock; a paper on a tornado in Illinois, by Mr. Chappelsmith; a description of a great storm affecting both America and Europe, by Professor Loomis; an article on the heat and light of the sun at different points, by Mr. Meech; a study of the secular period of the aurora, by Professor Olmsted; and an account of the occurrence of auroras in the Arctic regions, by Mr. P. Force. In addition to these papers published directly by the Institution, Secretary Henry prepared a number of important articles on meteorological subjects based on the Smithsonian investigations, which were published in the agricultural reports at that time issued by the Patent Office.

At the outbreak of the Civil War the volunteer weather observers numbered several hundred; in fact every district of any size in the United States, besides several in Canada, Mexico, Central America, South America, and the West Indies, had one or more observers reporting weather conditions to the Smithsonian. These observers all served entirely without compensation, their only return being a hearty acknowledgment of assistance rendered, copies of Smithsonian publications, and the satisfaction of contributing to investigations which were producing most interesting and popular results. With the coming of civil strife, however, the system was considerably disrupted, no records at all being received from the Southern States. Many of the observers in the North being called for military service, the reports from this region also were fragmentary. This unsatisfactory condition continued throughout the years of the war; but with the cessation of hostilities, the volunteer observers quickly took up their work again, and by 1866 the Smithsonian meteorological investigations were nearly back to their normal status. In this year Professor Henry, in reporting on the progress of the studies, wrote:

"Indeed, the results which have been already derived from the series of combined observations in this country, fully justify the wisdom and forethought of those who were instrumental in establishing them. Although their organization was imperfect, the observers, in most cases, untrained, and the instruments of an inferior character; yet they have furnished data which, through the labors of Redfield, Espy, and Hare, whose memories are preserved in the history of science, have led to the establishment of principles of high theoretical interest, as well as of great practical value. Among these I need here mention only the fact now fully proved that all the meteorological phenomena of at least the middle and more northern portions of the temperate zone are transmitted from west to east. The passage of storms from one part

of the country to the other was noticed by Doctor Franklin on the occasion of observing an eclipse of the moon. He showed that our northeast storms are felt successively later and later as the point of observation is further to the northeast; that they arrive last at the extreme northeastern portions of our continent. We now know, however, that the successive appearance of the storm at points further along the coast is due to the easterly movement, sideways as it were, of an atmospheric disturbance greatly elongated north and south and reaching sometimes from Canada to the Gulf of Mexico."

And in the same year, 1866, Professor Henry predicted, though with scientific caution, the future progress of meteorology as follows:

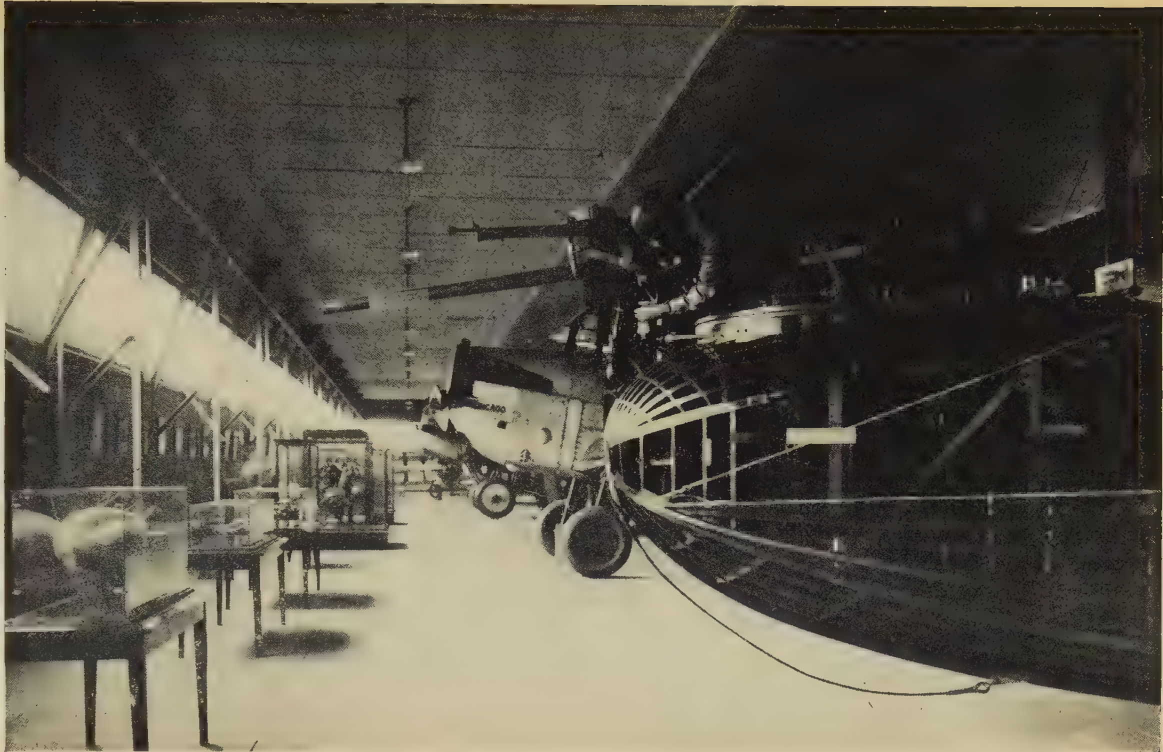
"From the great interest which has been awakened in regard to meteorology throughout the world and the improved methods which have been adopted in its study, it can scarcely be doubted that in a few years the laws of the general movements of the atmosphere will be ascertained, and the causes of many phenomena of the weather, which have heretofore been regarded as little else than the capricious and abnormal impulses of nature, will become adequately known; although, from the number of these causes, and the complexity of the resultant effect, it may never be possible to deduce accurate predictions as to the time and particular mode of their occurrence."

The number of observers reporting to the Institution continued to be augmented year by year, so that in 1867 the number was 352; in 1868, 400; in 1869, 479; and in 1870, 515. Appreciating the steady increase in the scope of the work and the importance of the results being published by the Institution, Professor Henry had some time before recognized that it was not possible for the Smithsonian, with its very limited financial resources, long to continue the meteorological work as it should develop. With this in mind he had urged upon Congress

for a number of successive years the necessity of establishing a distinct meteorological department of the Government, with a comprehensive plan of organization and with sufficient funds to make of it a central agency for meteorological investigations in America, as well as for the forecasting of weather conditions.

In 1870 Congress finally took action in the matter by providing for a system of practical weather reports under the direction of the Signal Service of the War Department. In this year, it being obvious that thereafter the Government would take care of the meteorological interests of the country, Professor Henry took occasion to sum up in his annual report the value of the Smithsonian's pioneer work in this branch of science, in these words:

"It has done good service to the cause of meteorology: (1) in inaugurating the system which has been in operation upward of twenty years; (2) in the introduction of improved instruments after discussion and experiments; (3) in preparing and publishing at its expense an extensive series of meteorological tables; (4) in reducing and discussing the meteorological material which could be obtained from all the records from the first settlement of the country till within a few years; (5) in being the first to show the practicability of telegraphic weather signals; (6) in publishing records and discussions made at its own expense, of the Arctic expeditions of Kane, Hayes, and McClintock; (7) in discussing and publishing a number of series of special records embracing periods of from twenty to fifty years—in different sections of the United States—of great interest in determining secular changes of the climate; (8) in the publication of a series of memoirs on various meteorological phenomena, embracing observations and discussions of storms, tornadoes, meteors, auroras, etc.; (9) in a diffusion of a knowledge of meteorology through its extensive unpublished correspondence and its printed circulars. It has done all in this line which its limited means would permit, and has urged



Part of the exhibit of famous airplanes in the Aircraft Building, Smithsonian Institution

upon Congress the establishment, with adequate appropriation of funds, of a meteorological department under one comprehensive plan, in which the records should be sent to a central depot for reduction, discussion, and final publication."

The new meteorological service under the Signal Service of the Army, ably organized and directed by General Myer, who wisely chose as his scientific assistant Professor Cleveland Abbe, one of the foremost of American meteorologists, at once entered into active and successful operation. In accordance with the Smithsonian's established policy of relinquishing going concerns, as it has done in several other instances, in order that the Smithson fund may not be expended for something that can be done as well by other agencies, Professor Henry in 1870 offered to turn over to the Signal Office all of the material which had been accumulated bearing on meteorology. He further advised that the Medical Corps of the Army, which had been gathering records of weather conditions since 1818, do the same thing, so that thereafter the study of meteorology in America might be centralized in one agency which would have in its possession all available data. As a result of this decision of Professor Henry's, in the belief that it was for the best interests of the science of meteorology, the entire system of observations built up and maintained for over twenty years by the Smithsonian Institution, was formally turned over to the Signal Service of the War Department. Regarding the transfer and as a last word to the hundreds of Smithsonian observers, who had for years faithfully recorded and reported weather conditions in their localities, Professor Henry wrote:

"This transfer, which has just been made, we trust will meet the approbation of the observers generally, and we hope they will continue their voluntary cooperation, not with the expectation of being fully repaid for their unremitted labor, in many cases for a long series of years,

but from the gratification which must result from the consciousness of having contributed to increase the sum of human knowledge. We trust also that the observers will continue to cherish an interest in the welfare and progress of the Smithsonian Institution, while, on our part we shall, in all cases and at all times, be pleased to continue to answer any communication which may be addressed to us by them on scientific subjects."

This event marked the close of the Smithsonian's active participation in meteorological investigations, although it continued to reduce certain of the early records, and meteorological papers appeared at times among its publications. Having fostered the accurate observing of the weather with standard instruments in many parts of the country; having inaugurated the telegraphic system of weather reports and established and maintained for a number of years the first daily weather map compiled from current data; and having for many years urged upon Congress the desirability and necessity of governmental organization and support of a central meteorological service, the Smithsonian Institution may justly claim to be the parent of the present U. S. Weather Bureau.

CHAPTER XIX

THE ORIGIN OF THE BUREAU OF FISHERIES

THE Chairmen of the Committees on Appropriations, in both House and Senate, received one day a message from Professor Spencer F. Baird, Assistant Secretary of the Smithsonian Institution. It was as follows:

"Smithsonian Institution,
"Washington, D. C.
"January 3d, 1871.

"DEAR SIR:

"I take the liberty of embodying in the form of a letter some of the ideas presented to you during our interview a few days ago, in reference to the subject of the food fishes of the New England Coast.

"During my visit of last summer to the Vineyard Sound & other maritime portions of New England, I was much impressed by the great diminution in the numbers of the fish which furnish the summer food supply to the Coast (as the Scup, Tautog, Herring, Sea Bass, Striped Bass, etc.) as compared with their abundance during a previous visit in 1863; & I found the same impression to be almost universal, on the part of those with whom I conversed on the subject. The belief is everywhere loudly expressed that unless some remedy be applied—whatever that may be—the time is not far distant when we shall lose, almost entirely, this source of subsistence & support—a calamity which would involve a vast number of evils in its train.

"The causes assigned by intelligent fishermen & resi-

dents along the coast, are very varied, most disinterested persons, however, ascribing the scarcity to the use of nets of one pattern or another, & the capturing of the fish on or near their breeding ground before they have spawned; & urging vehemently the passage of laws for preventing or regulating the employment of nets or weirs.

"State action has been invoked at various times, for the purpose of securing a remedy for the evil in question; but owing to conflicting interests and the influence of powerful parties who are concerned in maintaining the present mode of fishing, little has been accomplished, especially in view of the impression that seems to prevail with many, that the subject, if requiring legislation at all, must be provided for, in part at least, by the General Government, which controls the waters in which the fish are captured.

"The official inquiries into this subject have hitherto been mainly prosecuted by committees of State legislatures, before which persons interested, either in maintaining the nets or in abolishing them, have alone been summoned to give testimony. As might be expected, in a matter which involved the occupation and support of the parties examined, the evidence was directly contradictory; and it is not to be wondered at if diametrically opposite conclusions were reached, as in the case of the Massachusetts Committee, which saw no reason to interfere with the nets, and that of the Committees of Rhode Island and Connecticut, which recommended their immediate and peremptory removal. I think, however, that the mean lies between the two extremes and that a proper investigation will show a time when the use of the nets should be suspended, so as not to interfere with the breeding fish, while the capture of the full-grown ones may be permitted at another period. Millions of dollars are invested in the fish pounds and nets, and in the manure and guano establishments dependent upon them for materials; and so important an interest should not be

struck down at a blow, if a satisfactory compromise can be effected.

"Before intelligent legislation can be initiated, however, and measures taken that will not unduly oppress or interfere with interests already established, it is necessary that a careful, scientific research be entered upon, for the purpose of determining what should really be done; since any action presupposes a knowledge of the history and habits of the fish of our coast that, I am sorry to say, we do not at present possess. We must ascertain, among other facts, at what time the fish reach our coast, and during what period they remain; when they spawn and where; what is the nature of their food; what localities they prefer; what agencies interfere with the spawn or the young fish; what length of time elapses before the young themselves are capable of reproducing; for how many years the function of reproduction can be exercised; and many other points of equal importance.

"I would, therefore, suggest the appointment of a Fish Commissioner, on the part of the United States, whose duty it shall be to prosecute this investigation and report upon these points to Congress; and perhaps, after conference with the Fish Commissioners of the several States, advise what action, if any, should be taken, either by the General Government alone, or in conjunction with the States, to arrest the alleged impending extermination of our sea fishes, and bring their numbers back to that maximum which will secure an ample supply of wholesome food for the community, and at the same time furnish a means of comfortable living to persons engaged in the business.

"Cod and Mackerel are not concerned directly in this inquiry, as they are not captured to any great extent in pounds; but since they feed almost entirely on other fish, their abundance on or near our coast depends largely upon that of the kinds mentioned in the beginning of this letter.

"With regard to Salmon, Shad, and Alewives, which run up into inland ponds and streams to spawn, the protective measures now enforced by State legislatures, while these fish are in fresh water, are amply sufficient to secure their increase. There are, however, about forty species of food fishes, belonging almost exclusively to the salt water of the coast from the Bay of Fundy to the Gulf of Mexico, which require the consideration herein indicated.

"But for my fear of extending too greatly the already unreasonable length of this letter, I could adduce a great many well attested facts in support of the various propositions herewith presented; and should it be desired, they can be promptly furnished.

"Very respectfully,
(Signed) "SPENCER F. BAIRD,
"*Asst. Secretary, S. I.*"

The direct result of Professor Baird's suggestion is expressed in the Act of February 9, 1871:

"Whereas it is asserted that the most valuable food fishes of the coast and the lakes of the United States are rapidly diminishing in number, to the public injury, and so as materially to affect the interests of trade and commerce: Therefore,

"*Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled*, That the President be, and he hereby is, authorized and required to appoint, by and with the advice and consent of the Senate, from among the civil officers or employes of the Government, one person of proved scientific and practical acquaintance with the fishes of the coast, to be commissioner of fish and fisheries, to serve without additional salary.

"*Sec. 2. And be it further resolved*, That it shall be the duty of said commissioner to prosecute investigations and inquiries on the subject, with the view of ascertaining

whether any and what diminution in the number of the food fishes of the coast and the lakes of the United States has taken place; and, if so, to what causes the same is due; and also whether any and what protective, prohibitory, or precautionary measures should be adopted in the premises; and to report upon the same to Congress.

"*Sec. 3. And be it further resolved*, That the heads of the Executive Departments be, and they are hereby, directed to cause to be rendered all necessary and practicable aid to the said commissioner in the prosecution of the investigations and inquiries aforesaid.

"*Sec. 4. And be it further resolved*, That it shall be lawful for said commissioner to take, or cause to be taken, at all times, in the waters of the seacoast of the United States, where the tide ebbs and flows, and also in the waters of the lakes, such fish or specimens thereof as may in his judgment, from time to time, be needful or proper for the conduct of his duties as aforesaid, any law, custom, or usage of any State to the contrary notwithstanding."

The office of Commissioner as described in this bill left no doubt as to the fact that it was intended for Professor Baird, since there was but one other person in the country qualified to fill it and he would not have desired to become Baird's rival. The provision of no salary for the position was in accord with Baird's insistence.

One of the first necessities apparent to Baird was the selection of a seacoast headquarters with suitable laboratories and wharves in a region accessible to points on the southern New England coast where the decrease in food fishes was more apparent. After careful investigation of a number of localities, he finally decided upon Woods Hole, a small village on the coast of Massachusetts about eighteen miles from New Bedford. Here was an excellent harbor for any vessels which might be used by the Commission, and its distance from large towns, combined with the unusually strong tide, kept the

water clean and uncontaminated, offering ideal conditions for experiments in the hatching of fish and lobsters. Having selected this very favorable permanent headquarters for the research work of the Commission, Baird succeeded in interesting friends of the work to purchase a considerable tract of land for the purpose, jurisdiction over which was ceded by the State of Massachusetts to the Federal Government. Appropriations were secured from Congress for the erection of the necessary buildings and wharves, and within a few years after the inauguration of the Commission, important research work was carried on at Woods Hole every season.

A number of volunteer assistants soon gathered, drawn by the excellent opportunities presented for studies in marine biology. Although authority to establish a laboratory for students was not contained in the law, Baird offered every encouragement and facility for the work of these scientists, and they in return were of material assistance in the scientific work of the fisheries investigation. These volunteer workers included A. E. Verrill, S. I. Smith, W. G. Farlow, J. W. P. Jenks, Alpheus Hyatt, and several others. Thus were laid the foundations for the present well-known marine biological laboratory at Woods Hole.

The work of the Fish Commission early divided itself into two major sections: one, the investigation of the statistics and natural history of the fishes and other products of the water and their relationships to each other, including the various methods of capture and utilization, form of apparatus required, etc.; the other, the increase in the supply of food fishes, either by artificial propagation or by transportation.

At the end of two summer seasons, Baird had reached very definite conclusions. It was established that the decrease in numbers of food fishes had been going on for at least twenty years, gradually at first, but much more abruptly beginning about 1865. By 1871 the reduction in

Marine biological station at Woods Hole, Massachusetts, established by Secretary Baird

PLATE 103

U. S. Fisheries steamer *Albatross*, completely equipped for marine studies

numbers was so great that successful fishing with hook and line was entirely prevented. Two reasons for this alarming decrease became apparent; first, the increased use of traps and pounds for capturing the fish, resulting in the destruction of a large percentage of spawning fish before they deposited their eggs; and second, the devouring of immense numbers of the young fish by the voracious bluefish.

As it was not practicable or desirable to destroy the bluefish, themselves an important article of food, the obvious alternative was to regulate the use of traps and pounds during the spawning season. The principal profit from the operation of the traps was made during that period; hence in order that too great hardship might not be worked on the owners of these devices, Baird recommended that their use be prohibited only from Friday night until Monday morning each week during the spawning season.

The work of the Fish Commission was at the beginning expected to require only one or at most two years, and there was appropriated for the first year's work the sum of five thousand dollars. During the second year of the work, it became apparent that the excellent accomplishment up to that time was only a beginning, and in this year the American Fish Culture Association succeeded in having added to the duties of the Commission the establishing of fish hatcheries. The Association had in mind particularly the fresh-water fishes, because of the alarming decrease of trout and the entire disappearance of salmon from the rivers of Maine. But Baird later added hatcheries for the food fishes of the sea, and the raising of both fresh-water and marine forms met with remarkable success. The greatly depleted supply of inshore cod was notably restored; the shad of the eastern coast was transferred to the Pacific with such success that this fish soon became common in the Western markets; and the salmon fisheries of the southern Pacific coast, which had almost

reached a state of complete exhaustion, were fully repopulated by the successful operation of salmon hatcheries.

From the modest beginning, in 1871, of five thousand dollars, the work gradually increased in scope and magnitude until in 1886, the last year of Professor Baird's active direction of the Commission, an appropriation was required of nearly a quarter of a million dollars.

Besides the principal station and headquarters at Woods Hole, other stations for investigation and research were located at Gloucester, Massachusetts, and Saint Jerome, Maryland. For the propagation of salmon, whitefish, trout, shad, carp, and other important food fishes, a number of stations were maintained, including two in the state of Maine, two in Michigan, two in California, one in Virginia, one in New York, two in Maryland, two in New Jersey, and three in Washington, D. C. The artificial propagation proved highly successful, millions of eggs being hatched at the various stations and the young fish planted where it seemed most desirable. This artificial increase in many cases largely offset the decrease in numbers due to the more numerous and more effective methods of capturing the fish. In several cases, notably that of the inshore cod fishing, seriously depleted fisheries were measurably restored.

One of the first essentials in prosecuting the fisheries investigations along the seacoast was a vessel, in order that accurate and extensive information might be secured bearing on the decrease of fishes and its probable cause. Regarding the various kinds of fishes, it was necessary to know their geographical distribution; abundance at different periods of the year; migrations and movements; relationships to other species; food; and peculiarities of reproduction. It was also desirable to have a thorough knowledge of the animal and vegetable life of the sea, upon which the fishes feed, as well as of the larger species of fish which in turn prey upon them. Furthermore, it was obvious that a thorough investigation of the

chemical and physical character of the water itself, its temperature at different depths, chemical constitution, currents, and other factors, would have an important bearing on the fisheries problem. Such information could be obtained only by the constant use of a special ship with suitable apparatus, and Baird from the beginning of the work bent his efforts to securing such a ship. During the early years of the investigation, the small appropriations available made the construction of a special ship out of the question, and Baird availed himself of the cooperation of various Government agencies in the loan of certain vessels during the summer months.

For the first season, use was made of a small sloop yacht, the *Mazeppa*, loaned through the courtesy of the New Bedford custom-house. The next year and each season thereafter until 1875, the Navy Department detailed to the Fish Commission the 100-foot steam tug, *Blue Light*. This vessel, with certain alterations, was admirably adapted to the work of the Commission, and more extensive cruises could be undertaken. She was equipped with up-to-date dredges and trawls, and through her use many important observations and collections were made bearing on the problems of the fisheries. In the years 1877 and 1878, the Navy provided the larger steam tug, the *Speedwell*, which enabled Baird to undertake investigations at great distances from the coast.

In 1880 there was completed the steamer *Fish Hawk*, authorized by Congress to serve as a floating hatching house for the production of shad, herring, striped bass, and other food fishes, capable of being moved to any place where the breeding fish could be found in sufficient quantity. Her outfit included all the apparatus necessary not only for the hatching of fish but also for scientific research generally, including a hoisting engine of great capacity, and a full equipment of dredges, trawls, deep-sea thermometers, etc. The excellent results subsequently obtained through the use of the *Fish Hawk* demonstrated

fully the value of using specially constructed vessels for the work of the Fish Commission.

For the purpose of determining the lines of migration and winter habitat of the mackerel, bluefish, menhaden, and other deep-sea fishes, Baird for a number of years urged upon Congress the desirability of constructing a sea-going steamer, and in 1881 an appropriation was granted for this purpose. The original appropriation was found to be insufficient, but with an additional amount allowed the following year, bringing the total up to $145,000, it was possible to award the contract to Pusey and Jones, of Wilmington. This vessel, named the *Albatross*, was commenced in March, 1882, and made her trial trip in December of the same year. After certain alterations and repairs, she was ready for the work of the Commission, and her first cruise started in April, 1883.

The *Albatross* was an iron twin-screw steamer with an over-all length of 234 feet and a net tonnage of 384. Besides the regular accommodations for the officers and crew of such a vessel, she was equipped with staterooms and laboratories for the use of the naturalists who would be attached to the staff. Special engines were provided for dredging, trawling, and sounding, and the most efficient dredges, traps, and other devices for capturing the creatures of the sea were installed. The ship proved to be particularly seaworthy and admirable in every respect for the deep-sea work of the Commission.

The officers and crew were detailed to the *Albatross* by the Navy Department, and Lieutenant-Commander Z. L. Tanner, U. S. N., was placed in command. On April 24, 1883, she put to sea, under orders to investigate the conditions which govern the movements of the mackerel, menhaden, bluefish, and other migratory species, beginning off Cape Hatteras and following up the schools of fish in their movements. The physical conditions of the surroundings as to temperature and currents and also the chemical and biological peculiarities of the

water were to be determined, and dredging and trawling operations were to be carried on whenever opportunity offered. In addition, orders were given by Baird to communicate with all fishing vessels which might be encountered, obtaining from them information regarding the abundance of fish and the movements of the schools.

During this maiden cruise and others which followed in the first year of service of the *Albatross*, a large amount of new information was secured bearing on the distribution and migrations of the deep-sea fishes, besides extensive collections of marine biological material, much of it new to science, for the National Museum. During subsequent seasons the *Albatross* continued the dredging and trawling operations and the study of the migrations and other movements of the deep-sea fishes, and the practical and scientific results of her work proved to be of the greatest value.

Another vessel authorized by Congress at Baird's request was the *Grampus*, a ninety-foot, two-masted schooner provided with a well in which marine fishes could be kept alive and transported from the fishing grounds to the hatching stations on the coast where the eggs could be secured for the purpose of artificial propagation. She was also specially adapted for making researches at sea, for the discovery of new fishing grounds, and for the investigation of those already known.

Baird's extensive work as Commissioner of Fish and Fisheries was done, as stipulated in the law creating the office, entirely without compensation, and was carried on in addition to his exacting duties as Assistant Secretary of the Smithsonian. In order to avoid interference with the Smithsonian work, Baird found it necessary to devote the early morning hours and the evenings after the completion of his day's work at the Smithsonian to the heavy correspondence and other matters relating to his duties as Commissioner. This extra work required on the average about six hours a day, and was a severe drain on Baird's

strength. With his succession to the office of Secretary of the Smithsonian in 1878, his duties were so increased that in order to continue as Commissioner of Fisheries, he was forced to give up all outside work with which he had augmented his private income. In addition to this financial loss, Baird turned over a portion of his residence in Washington as offices for the Fish Commission, and together with certain expenses connected with the station at Woods Hole which he personally defrayed, the total cost of the work to him was no less than two thousand dollars a year.

In view of his extremely generous giving of time and money for the work of the Commission, it seems almost incredible that he should have been attacked and misrepresented; yet this occurred, and it was necessary for Baird to return to Washington one summer from his work at Woods Hole to explain certain vouchers which had been held up by the Treasury Department, and to quiet slanderous stories which had been allowed to circulate about him and the work of the Commission. Of course the vouchers were shown to be entirely regular, and the stories were proved to be pure fiction, but the unfairness of these attacks greatly affected Baird and they were an added drain on his failing health. Being warned by specialists that he must avoid overwork, it is interesting to note that he makes a resolution in his Journal to do no more work after six p.m.

From a borrowed shed and wharf, and research equipment in the shape of a thirty-foot sloop, the U. S. Fish Commission grew in sixteen years into a nation-wide investigation of the whole subject of fisheries. It occupied for research work three permanent stations on the Atlantic Coast; it maintained a considerable number of other stations throughout the country for the artificial propagation of food fishes; and it possessed a small fleet of specially constructed vessels. In short, it had shown the world the way to the conservation of a univer-

sal resource. The achievement of these sixteen years from 1871 to 1887, the date of Baird's death, represented the fruits of one man's spare time. The U. S. Bureau of Fisheries, now combined with the Biological Survey under the name Fish and Wildlife Service, stands as a fitting monument to so great labors.

It is worthy of comment that though Secretary Baird built up the Fish Commission in his spare time, the work was by no means unconnected with the Smithsonian Institution. The secret of the Commission's sound organization lay in the thorough scientific understanding of fishes; and that understanding was to be found only in an institution such as the Smithsonian, which ranges over the whole of nature in quest of knowledge without limiting itself by utilitarian considerations. The universal respect felt for the Smithsonian gave to the new Commission at the very outset a certain prestige helpful in both forestalling opposition and insuring cooperation. And its quasi-governmental position made the resources of the Government available to it as they would not have been to a private institution. In fact, the organization of the Fish Commission illustrates excellently the special facilities enjoyed by the Smithsonian for developing scientific work under the Government.

CHAPTER XX

RECENT SMITHSONIAN ACTIVITIES

1. A New Research Division

All life depends upon radiation from the sun. Vegetable life depends upon light to assist it in assimilating carbon dioxide from the atmosphere, and all animal life depends upon vegetable life. With the financial assistance of the Research Corporation of New York, a new division of the Smithsonian, the Division of Radiation and Organisms, was established in 1929 to study the relation between radiation and plant growth.

In dark basement rooms of the Smithsonian building, a staff of highly specialized scientists is experimenting with sunlight. If this seems paradoxical, it should be recalled that in exact studies of the effect of radiation on plants, all conditions must be exactly controlled. The exact wave lengths of light being used must be known, so that basement rooms are really ideal for such researches, for sunlight can be brought in by the use of mirrors, or artificial light, which in the last analysis is modified sunlight, of specified wave lengths and intensities can be used.

The offices of the new division are located in the 140-foot flag tower of the Smithsonian building. For many years this tower had been occupied chiefly by bats and spiders, and the only way to reach the top was by means of a spiral stairway such as we see in lighthouses. Dr. Abbot conceived the idea of converting this waste space into offices, and accordingly the whole interior of the tower was remodeled. The stairway was torn out, concrete floors were put in at proper intervals, an automatic elevator was installed, and other necessary changes were effected which

all together made of the tower a miniature skyscraper. There are now seven modern offices, one on each floor, all with excellent light and easily reached by the elevator. Likewise, the west end of the Smithsonian basement, formerly storage and waste space, was remodeled into a series of modern laboratories with all the facilities needed for research in radiation. Besides the machine shop and glass room, each in charge of a highly skilled technician, there is a chemical laboratory; one small room each for the ultraviolet spectrographs, the infrared spectrograph, the monochromators, and the photometer; two plant-growth rooms; an inoculation room; a photographic room, and a darkened and air-conditioned experimental room.

The first few years of the existence of the new division were devoted largely to the making and installing of the necessary apparatus, which for radiation investigations is extremely delicate and complicated. Most of the devices are for the purpose of producing light of exactly known wave length and intensity and providing absolute control of physical and chemical conditions during the course of the experiments with growing plants.

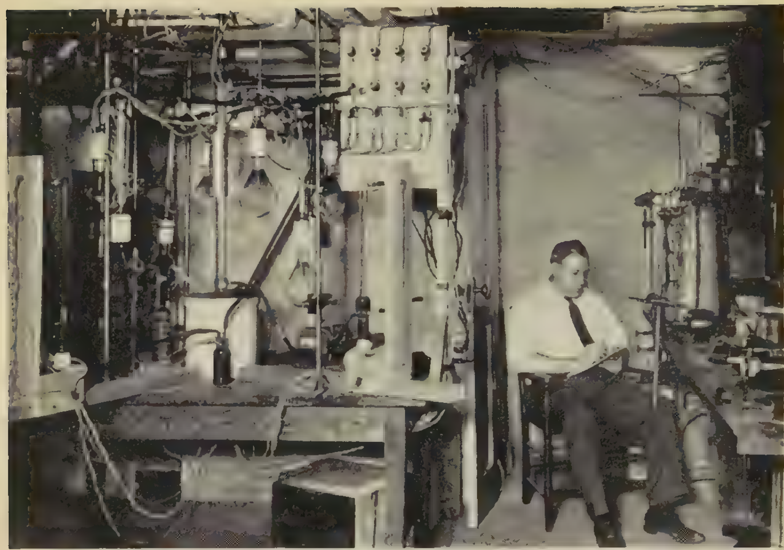
Actual experiments on the effect of radiation on the growth of plants under various conditions have been carried on for several years. A number of these will be described briefly, but it must be borne in mind that the investigations are highly technical in character and that the aim of the division, like that of other departments of the Smithsonian Institution, is to discover the fundamental underlying principles involved in its experimental findings, with no thought of immediate practical application. The history of scientific research has shown that whenever new facts are established, application of these facts for the benefit of mankind has not been long in following.

The very existence of life on the earth depends upon the complicated chemical reaction in plants known as photosynthesis. By this process, a plant unites carbon dioxide and water in the presence of light and of chlorophyll, the

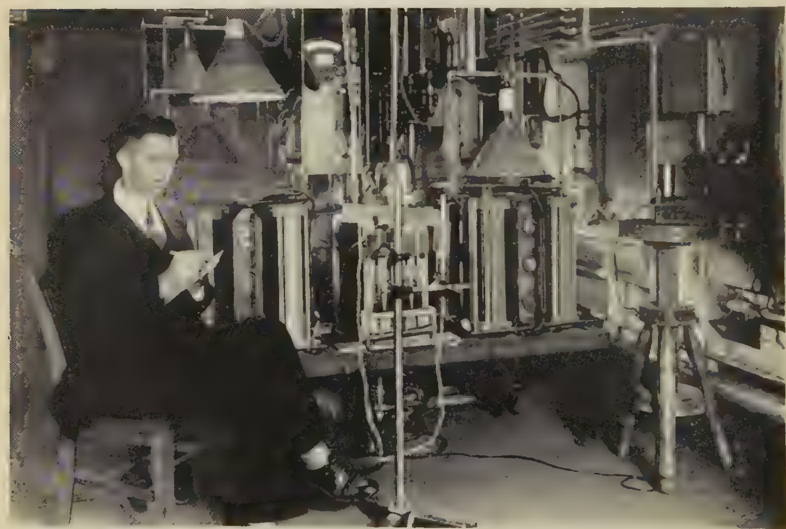
green plant pigment, to form sugars and starch. What wave lengths, or colors, of light are useful to the plant in absorbing carbon dioxide from the air? To determine this important point, Smithsonian scientists separated out, by means of a specially constructed filter, narrow bands of light of a single color, and with these known wave lengths irradiated wheat plants growing in a glass tube under controlled temperature and moisture conditions. A device to measure the carbon dioxide concentration in the air flowing over the plants completed the apparatus, and the experiments were run with both sunlight and artificial light. The results were as follows: red rays give plants the greatest aid in assimilating carbon dioxide, blue rays are second, green and yellow rays are useful, but infrared and ultraviolet rays are of no help. It is planned to extend these experiments to plants other than wheat.

Everyone has observed the bending of house plants such as geraniums toward the light. This phenomenon, known as phototropism, has been studied for many years by numerous experimenters in the effort to learn the actual cause and mechanism of the bending. The opinion is now that the bending is due to unequal distribution of growth-promoting substance on the lighted and shaded sides. The Division of Radiation and Organisms at the Smithsonian wished to go further and attempt to determine why more growth substance occurs on the shaded side, forcing the plant to bend toward the lighted side. Using oats and maize seedlings and terminal shoots of tobacco plants, the scientists of the Division made a series of experiments with carefully controlled light conditions to determine whether radiation of various kinds destroyed growth substance. The results of these experiments indicated that light of high intensity does destroy plant growth substance, whereas with lower light intensity, this substance may be moved to another part of the plant rather than destroyed. In other words, growth substance in the side of a plant that faces a strong light is destroyed, causing that side to grow

Smithsonian 145-foot flag tower recently remodeled into modern offices



A—Apparatus for determining effect of different wave lengths and intensities of light on photosynthesis



B—Apparatus for studying the effects of light on plant growth under controlled conditions

less than the side away from the light, with consequent bending. With a weaker light, the growth substance may simply move around to the shaded side of the plant, giving, of course, the same effect.

To learn the effect of different colors or wave lengths of light on this phenomenon of phototropism, oat seedlings were placed between two light sources of different color, for example, green light on one side and blue on the other. If the seedling bent toward one of the colors, the intensities of the two colors were adjusted until a new seedling introduced between them grew perfectly straight. From measurements of the relative intensities, it was learned that growth of oat seedlings is retarded most by blue light, and that orange and red light have no retarding effect.

Further experiments were devised to learn the effect of various wave lengths of light on algae, one of the lower forms of plant life. Pure cultures of single species of algae were grown on agar and subjected to radiation of known wave length and intensity. Multiplication of algal cells was found to be proportional to the intensity of illumination up to a certain limit. Irradiation of the cultures of algae with lights of different color gave the following results: Blue light increased the multiplication of cells by three times the normal amount, red and yellow light by twice normal, and green light decreased the multiplication. In infrared radiation and in darkness, little change from normal growth occurred.

Another series of experiments with algae concerned the lethal or killing effect of ultraviolet radiation on these plants. Glass plates were covered with green algae, and these plates were subjected to various periods of irradiation with ultraviolet light of various wave lengths. Ultraviolet light in excessive doses is the cause of the painful red sunburn resulting from the first outing of the summer season, and this type of radiation is what the newspapers like to speak of as the "death ray", as indeed it proves to be for the green algae. At wave lengths shorter than 3022

angstroms, which is the approximate limit of the ultraviolet that reaches the earth from the sun, the algae were killed after varying periods of exposure to the radiation. Strangely enough, much shorter exposures to these same deadly wave lengths proved to have a stimulating effect on the algae.

Another investigation of particular importance concerns the development of a method of instantaneous measurements of the carbon dioxide assimilation and the respiration of plants and other living organisms. Using this new method, the scientists of the Division have obtained important information on the time course of photosynthesis, that process by which plants in the presence of light convert carbon dioxide taken from the air to sugars and starch. Photosynthesis has been called the most important chemical reaction in the world, for without it life could not exist on earth. Still other researches have indicated that normal growth of tomato plants can be obtained with artificial light provided the near infrared radiation is cut off; that when using mixtures of various wave lengths, one mixture may be more effective in promoting plant growth than other mixtures with a greater intensity; and that polarized light has no effect different from that of ordinary light on plant growth.

So this latest research division of the Smithsonian Institution holds great promise of contributing important discoveries in the comparatively new science of radiation. A staff of highly skilled investigators in biology, physics, and chemistry has been assembled, most of the necessary specialized apparatus has been installed, and a good start has been made in the research program contemplated. In 1941 Congress provided an appropriation for its operation as a division of the Smithsonian Astrophysical Observatory.

2. *New Art Developments*

If those members of Congress who in 1846 enacted the law establishing the Smithsonian Institution could come

back to earth today, they would be amazed and delighted at the present glowing prospects for a great development of art in association with the Institution. They provided for a gallery of art among the other activities outlined for the Smithsonian, but for over half a century this feature lay dormant. It is true, the Institution possessed a number of small collections of paintings, etchings, and other art works which were exhibited in various parts of the original Smithsonian building, but hardly did these deserve the dignity of the name "gallery of art." More collections were added gradually, however, and when the Natural History Building of the National Museum was completed in 1910, all the Institution's art works were assembled for exhibition in the central range of the new building. In 1920 Congress recognized the growing importance of the collections and created a separate bureau under the Smithsonian to be known as the National Gallery of Art. Then in 1923 came the opening of the Freer Gallery of Art, the culmination of Charles L. Freer's gift to the Nation of his famous collection of Oriental art and American paintings, together with a beautiful building to house them, which formed a separate unit of the National Gallery. Finally the Institution received as a gift the great Gellatley collection of paintings, sculpture, and many other types of art objects, and there the Nation's art collections stood until 1937, when the greatest impetus of all was provided by the Mellon gift.

Andrew W. Mellon in that year gave to the American Nation, through the Smithsonian Institution, his unexcelled collection of old masters together with a $15,000,000 building for their care and an endowment of $5,000,000. This gift, with its stated provisions for adding only the finest obtainable works of the great artists, will surely in a short time place the United States in the front rank among the nations in art development. For the paintings he brought together, although only slightly over a hundred in number, are all the work of the greatest masters of Europe,

and each is the finest example that could be obtained of the artist's work. In the collection are exceptional works by such painters as Raphael, Botticelli, Fra Angelico, and Titian of the Italian school; Van Eyck, Christus, Memling, Rubens, and Van Dyck of the Flemish school; the Dutch painters Rembrandt, Hals, Vermeer, and Hobbema; and also the most famous Spanish, British, French, and German painters. Besides this unexcelled collection of old masters, Mr. Mellon's gift included a large number of portraits by leading American painters, and the famous Dreyfus collection of Renaissance sculptures.

Mr. Mellon made his formal offer in December 1936 to President Roosevelt and a few months later Congress expressed its acceptance in a Joint Resolution approved by the President on March 24, 1937. The resolution gave to the new gallery the name "National Gallery of Art," assigning to the collection formerly so called the name "National Collection of Fine Arts." The new gallery was made a bureau of the Smithsonian, but the actual direction of its affairs is in the hands of a board of nine trustees, one of whom is the Secretary of the Smithsonian. A site for the proposed building was provided on the north side of the famous Mall development of Washington, only a few blocks from the United States Capitol building. As soon as the arrangements were completed between the Smithsonian Institution and Mr. Mellon's representatives, work was begun on the building. The architect selected for the building was John Russell Pope, known for his outstanding work on many art galleries, museums, and other public buildings. It is indeed a tragic coincidence that Mr. Mellon and Mr. Pope died within 24 hours of each other in August 1937, so that neither saw the realization of his dream for a National Gallery of Art unsurpassed anywhere in the world. But those dreams have nevertheless become a reality, and the great marble building on the Mall was completed and opened to the public in 1941. Shortly thereafter, there were added to the original Mel-

National Gallery of Art on the Mall in Washington

PLATE 108

Rehearsal of one of "The World Is Yours" radio programs in the NBC studios in New York

lon art treasures the famous Kress and Widener collections. In the first fiscal year after the opening, more than 2,000,000 visitors entered the doors of the National Gallery of Art to derive enjoyment and instruction from the finest art works of all times. All credit is due Mr. Andrew W. Mellon for his generous and patriotic gift to the American people.

A correlative of the Mellon gift is the action of Congress in 1938 of appropriating $40,000 for preparation of plans for a Smithsonian Gallery of Art and setting aside for it a suitable tract of land near the Smithsonian group of buildings and the new National Gallery building. It is the expectation that funds will be forthcoming from private sources for the actual construction of the building. In this Smithsonian Gallery would be installed the present National Collection of Fine Arts, valued at $10,000,000, and the accretions in all branches of contemporary art that will unquestionably come to the Smithsonian when a suitable gallery building is available.

With the existing Freer Gallery with its unsurpassed collection of Oriental art, and with these two new galleries completed—the National Gallery devoted to the finest masterpieces of classic painting and sculpture, the Smithsonian Gallery providing for the national collection of art objects of all kinds—a long stride will have been taken toward giving America, through the Smithsonian Institution, her proper place in the field of art.

3. The Smithsonian on the Air

Men have searched the earth, the air, and even the sun and stars in their never-ending quest for knowledge. And now in an NBC educational feature, the United States Department of the Interior, Office of Education, brings you the wonders of that unique establishment, the Smithsonian Institution, dedicated to the increase and diffusion of knowledge.

Every Sunday afternoon for six years hundreds of thousands of families in all parts of the United States and

many in Canada, England, South America, and elsewhere gathered around their radios to hear a dramatization of another chapter of science, art, or history through the nation-wide broadcast "The World is Yours." Perhaps the program was the story of gold, with stirring dramas of the early gold rushes and of the bloody conflicts brought on by the lure of Montezuma's golden hoard for Cortez and his followers. Or perhaps the subject was "George Washington—the Man," a dramatic story depicting the sterling traits of character that made Washington not only the leader to whom his countrymen looked in the dark days of the American Revolution, but also the most loved man in America. In the thrilling story of De Soto's journey through the North American wilderness to the Mississippi—but before we tell De Soto's story as dramatized on the air, let us see how this unusual series of broadcasts originated and what its significance was.

For the past ten years or more, thinking people have realized the great influence that radio is bound to have on American thought in the future and have striven to find types of programs that would instruct listeners and at the same time be sufficiently entertaining to compete for their attention with the many purely entertainment broadcasts. For the radio audience is different from any other type of audience—if the radio listener finds a particular program not sufficiently interesting, with a flick of the dial he tunes it out and finds another more to his liking. The lecture and dialog forms of educational programs have been tried and found to be lacking in wide popular appeal. So in 1936 the Office of Education of the United States Department of the Interior entered upon a series of experimental broadcasts, with the financial aid of the Works Progress Administration, to determine the type of educational program that would both instruct and entertain. One of the types to be tried was the dramatized program on serious topics, and a cooperative arrangement was made with the

Smithsonian Institution whereby the Institution's experts in science, history, and art would provide the information for a program and the Office of Education's experts in radio presentation would put it on the air. The National Broadcasting Company agreed to provide a half-hour each week over a nation-wide network, and the first program went on the air June 7, 1936.

The subjects presented have been as diversified as the interests of the Smithsonian. Biology has been represented by such topics as "Whales, the Largest Mammals", "Man against Insects", "Life in the Sea", "Life under the Microscope." Geology has given "The Story of Gold", "Comets and Meteorites", "Land versus Weather", and many more. In the field of anthropology have been heard "Early Man", "The Mound Builders", "The Inca Empire of the Sun", and "Pueblo Indians." Other programs have fallen under the headings of history, art, aeronautics, astrophysics, radiation, and many other fields of human interest. Every program was dramatized by a large and capable cast of radio actors, with the assistance of an orchestra, a chorus, sound effects, and other adjuncts of professional broadcasts.

To illustrate the method of making these educational programs appeal to a large audience of a wide range of ages, let me describe briefly the broadcast on "The True De Soto." The story opens in 16th century Spain, with Hernando De Soto, a youth of 14, in the garden of Count Don Pedro de Avila, his guardian. With him is the beautiful young daughter of Count de Avila, Dona, with whom the boy is in love. He is telling Dona that he is going to ask her father for her hand, but at that very moment the father calls for him and gives him an exciting piece of news—the boy is to accompany him to the New World, to America. Dona tells him she will wait for him to return, and the next scene takes us to the wilderness of Florida, where the Spanish colony has been established for several years. De Soto, now reached manhood, has been made an

officer, and time after time he has risked his life in perilous undertakings in the savage wilderness.

He is sent to explore Nicaragua, but still the supposed wealth to be found in the new land escapes him. But he and the Spaniards push on farther and farther south until they reach Peru and the great Inca Empire of the Sun. Here the plundering conquerors find their desires realized at last—gold beyond their wildest dreams; and so 22 years after he had left Spain, De Soto sailed back to Spain, a soldier of reputation and a man of wealth. He found Dona still waiting for him and they were married. For two years he lived peacefully in Spain honored by all the high officials of the land, but the fever of exploring new lands and of the search for gold came upon him again and he set off once more for America, with the stirring tales of El Dorado in his ears.

After a stay in Florida trying to learn the location of the fabulously rich gold mine, El Dorado, the expedition starts through the wilderness in search of it. Then begins a fearful two years of struggling through the forests, crossing rivers and swamps, fighting hostile Indians, with De Soto battling alone against the growing discouragement and discontent of his men. Finally they set wondering eyes on the Father of Waters, the Mississippi River, and not long after, De Soto, wasted by years of privation, is stricken down by fever. The tragic story closes with the following dramatization of De Soto's lonely death.

VOICE:	Burning fever racks the body of De Soto. . . . Day after day he lies in his tent . . . wasting away from the fever. . . . He lies alone with his thoughts.
GHOSTLY VOICE:	(over echo mike) El Dorado, Hernando De Soto. . . . More gold than you know what to do with.
DONA:	(over echo mike) Come back to me, Hernando. . . . Come back to me.
VOICE:	Three hundred and fifty pounds of pearls.

DE AVILA: (over echo mike) There is opportunity for a strong young soldier in America. . . . Gold.

MAN: This is Peru, De Soto. . . . Another land to conquer. . . .

VOICE: You are becoming too ambitious, Hernando De Soto.

(NEXT VOICES IN MUCH DIFFERENT TONES AND IN VERY RAPID SUCCESSION)

MAN: Where is El Dorado now, De Soto? (laughs continuing into next speech)

DE AVILA: I want to help you Hernando. . . . Come to America with me. (Laughs a weird laugh.)

DONA: Don't go to Florida Hernando. . . . Don't go to Florida.

MAN: Look, De Soto. . . . The largest river ever seen by man! Look!

VOICE: Gold! . . . Tons of it!

(POURING OF MANY COINS OVER MUSIC)

(MUSIC UNDER VERY SOFTLY DRAMATIC)

VOICE: A river of gold, De Soto. . . . A mountain of gold, De Soto!

(TWO OR THREE WEIRD LAUGHS FOLLOWING EACH OTHER)

(MUSIC UP WITH A CRASH AND OUT SUDDENLY)

MAN: Governor De Soto. . . . De Soto, speak to me.

PEDRO: Is he . . .

MAN: Yes . . . De Soto is dead.

(MUSIC UP AND UNDER)

VOICE: De Soto was buried just outside the gate of the village, but the Indians noticed the freshly dug grave, and alarm spread among the Spaniards. In the dead of night they dug up the remains of the leader and carried him toward the river. Dirty, gray fog hangs over the Missis-

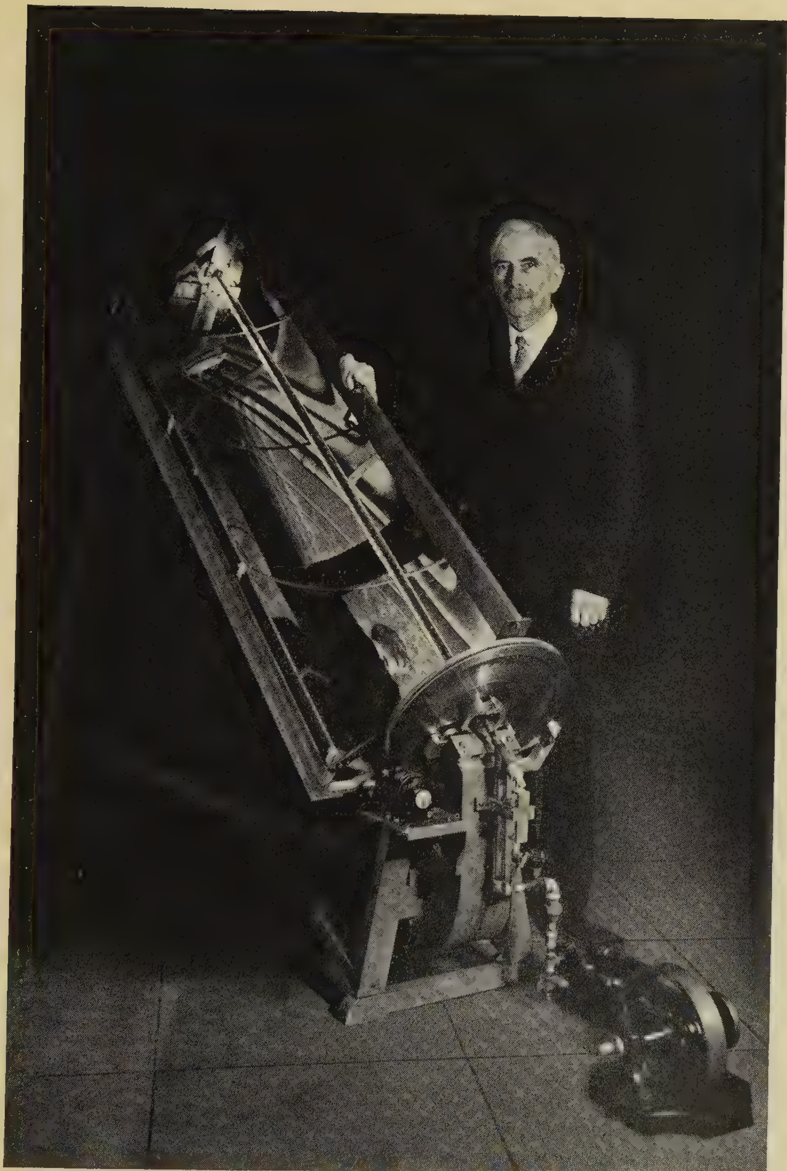
sippi. The moon scuds from behind a cloud, stares at the strange procession and then darkness falls over the river again. A boat pushes off from the shore . . . the river raises its muddy arms to receive the shrouded form of De Soto into its bosom. . . . His body hangs over the water for an instant . . . and then . . .

SOUND: (Splash)

VOICE: De Soto, the wanderer—De Soto the rainbow chaser—soldier, explorer, and trail blazer, disappears forever into the waters which he discovered. The bubbles swirl . . . the river carries them off into the fog.

The dramatizations were cleverly interspersed with authentic historical data and graphic description of the primitive peoples with whom De Soto came in contact, so that when the program ended the listener had been entertained and at the same time had broadened his knowledge of another chapter in human history.

How do we know that "The World is Yours" has been favorably received? By studying the same barometer used by commercial radio programs and movie stars—fan mail. From the time the program first went on the air in June 1936 to the time it was suspended in May 1942 fully half a million communications were received from listeners. No program can hope to please every listener, but the radio experts of the Office of Education were amazed at the almost complete unanimity of favorable mail response to the Smithsonian program. Many thousands of letters from all types and ages were enthusiastic in their praise of the programs, emphasizing the fact that they were both entertaining and instructive. From a questionnaire sent to listeners, 35,000 replies were received, which told us that the average number of persons at each radio was



Dr. Abbot and his latest solar engine

The search by Dr. Hrdlička for ancient human remains on the Aleutian Islands involves arduous work on such coasts as this one

four, that the ages ranged in fairly constant proportion from 9 to 60, that slightly more men than women listened to the programs, that the occupations of listeners included almost every known classification, and that the audience resided in every part of the United States and Canada.

From the beginning, "listener aids" were available to those requesting them. Starting modestly with a single mimeographed sheet of factual material relating to each program, these aids evolved into a small monthly magazine containing a brief illustrated popular article on each week's program for the month. The magazine was eagerly sought by listeners, with the result that in six months the edition reached 150,000. Unfortunately, available funds were insufficient to finance such a large edition, and publication had to be suspended. Thereafter the only supplementary material sent to listeners consisted of schedules of coming programs with brief reading lists of the best books on each subject to enable those sufficiently interested to expand their knowledge.

Upon the entry of the United States in World War II, the demand for radio time by military and governmental agencies forced the elimination of many educational and other sustaining programs, and in May 1942 "The World is Yours" had to be suspended for the duration.

4. Weather Studies and Sun Engines

Since 1918 the Smithsonian has measured and recorded the intensity of radiation from the sun. As these records piled up, it became increasingly clear that the solar radiation, instead of being constant as formerly supposed, varied from day to day and month to month. The variations appeared to be entirely irregular, but as many years of records became available, it occurred to Dr. Abbot, who had directed all these solar investigations, to

examine the curve of irregular variations for hidden periodicities: in other words, to see if the irregular variation was not in reality only a mixture of a number of regular variations of different periods. The difficult analysis was made, and there emerged 12 regular periodicities, which when recombined into a complex curve almost exactly reproduced the actual recorded curve of the sun's variation. As nearly as can be determined, these 12 periodic fluctuations had intervals of 23 years, 92, 68, 46, 39½, 34, 25, 21, 11, 9¾, 8, and 7 months. These are all nearly integral fractions of 23 years (or better, 274 months), which is the known length of a complete magnetic cycle of the sun.

Since this volume was originally written, the outstanding advance in this study of cycles has been the correlation of the solar periodicities mentioned above with variations of our earthly weather. I will not attempt to go far into this subject, for it is treated authoritatively by Dr. Abbot in volume 2 of this Series, but I will summarize briefly the indications thus far appearing from the investigations.

From the Smithsonian publication "World Weather Records" were taken the temperature and precipitation records for certain stations throughout the world where accurate observations had been made for approximately 100 years. Such stations included Helsingfors, Berlin, Copenhagen, Greenwich, Capetown, and Adelaide. After a very laborious analysis of the 100-year records for these cities, which involved thousands of pages of tabulations, the resulting curves of weather variation were scanned for periodicities, and there appeared every period but one that has been found for the sun's variation. Reversals of phase were found, it is true, but the reversals were discovered to be systematic so that they offered no insurmountable difficulty. These weather periodicities, of course, were also approximately integral fractions of the 23-year period, and Dr. Abbot felt that the next step was to study this funda-

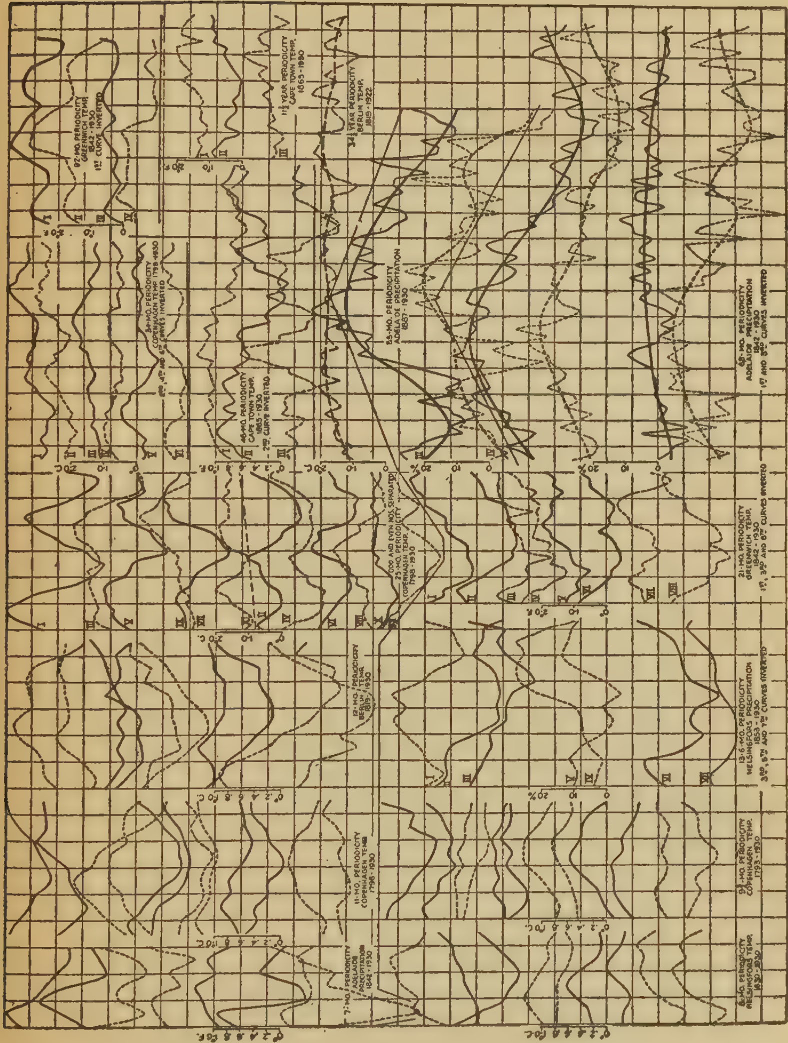


FIG. 1. Curves showing the various periodicities in weather found by Dr. Abbot for widely scattered stations.

mental period in weather and in other phenomena closely related to the weather.

The 23-year cycle was found not only in weather records, but also in the recorded levels of the Great Lakes, the level of the Nile River, in the catches of mackerel and cod in the Atlantic, in the width of tree rings for several hundred years back, and even in the thickness of varves, the layers formed by the annual deposit of sediment in Pleistocene glacial lakes. Although the 23-year cycle as observed in weather records in many localities is not repeated in identical form, being sometimes displaced in phase by a few months, yet the recurrences of weather features are sufficiently similar to give some promise of long-range forecasting. The indications from these studies, says Dr. Abbot, are that severe droughts may be expected beginning about 1975.

A later discovery concerning much shorter weather relationships indicates that opposite changes of solar radiation produce for at least 2 weeks after their commencement changes of temperature departures from normal which, though not the same for different stations, or for different months of the year, have this in common, that opposite solar changes produce opposite temperature departures. Dr. Abbot is convinced that if several more solar observing stations could be made available in addition to the three that have been operated for many years by the Smithsonian, giving daily values of the solar radiation accurate to 0.2 percent, certain features of the weather could probably be predicted for 2 weeks or more in advance.

Thus the Smithsonian, in the persons of Dr. Abbot and his colleagues, has been pursuing vigorously the very promising correlation between the variation of the sun and the variation of our weather, in the hope of eventually contributing to the making of long-range forecasting a reality. The study of weather is an extremely complex one, with all the complications created by variations due to local

conditions, and it is not to be expected that any easy solution will be found to the problem of forecasting weather variations from normal for long periods in advance. But from Dr. Abbot's years of intensive studies has come the strong probability that a major part of these variations from normal have their origin in the comparatively recently discovered variation in the radiation we receive from the sun.

A by-product of Dr. Abbot's many years of investigation of the sun is his development of a solar heat collector which he has used to operate a solar cooker and a small steam engine. The solar cooker, which will be found described briefly on pages 76 and 77 of this volume, is a practical device which has been used for several seasons by Dr. Abbot's field party for cooking all the meals at the Smithsonian station on Mount Wilson, California. The solar engine he has been developing gradually over a period of years, until today it is rapidly approaching the goal of a commercial power possibility.

The world's supply of the natural fuels—coal and oil—is not inexhaustible. Alarmists have several times during the past quarter century predicted the early depletion of these indispensable commodities, but always new reserves have been located, and their use, although increasing year by year, promises to continue for a considerable period of time. There will come a time, however—and that not in the remote future—when a threatened scarcity will raise prices to a point where it is necessary to find a more economical form of power for the world's work. When this time arrives, the vast amount of potential power lavished on the earth every day by the sun will doubtless be the answer to the problem. For the sun's energy wasted on the earth's deserts alone would be sufficient to furnish thousands of times the total amount of power now used by the whole world. The difficulty is to devise a practical, economical method of utilizing this great source of energy.

Dr. Abbot's latest solar engine model employs a para-

bolic aluminum mirror 2 feet wide and 6 feet long which focuses the sun's rays upon a glass tube within which is a miniature flash boiler. This consists essentially of a blackened steel tube containing a system of small water tubes soldered to the inside of the main tube and joined by copper wings. Water is supplied to the tube system at just the proper rate to cause it to burst into steam at the desired pressure, and hence steam is raised almost instantaneously when the sun rays strike the mirror. The mirror rotates by a small electric motor to follow the sun, the water tube remaining stationary. This small unit, which is comparatively simple and inexpensive to construct, could be used economically at the present time for small power jobs in a sunny locality.

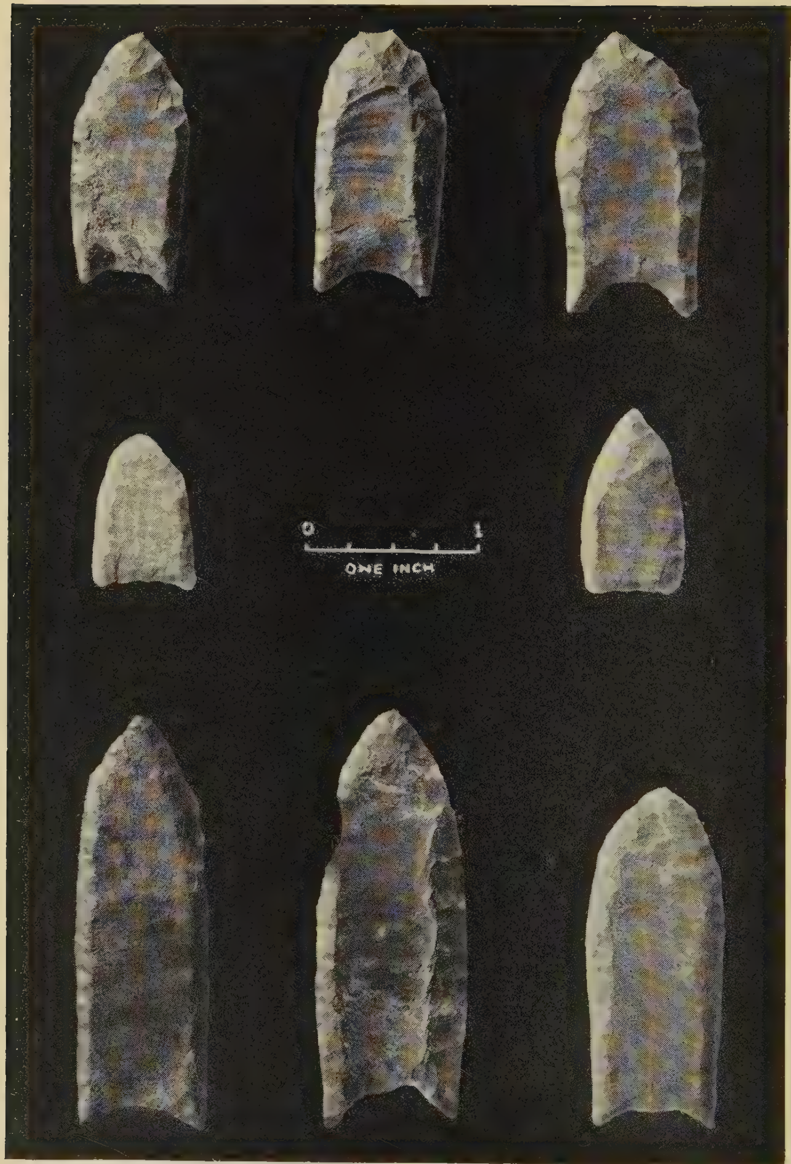
As to the future prospects for large power installations in desert regions, Dr. Abbot calculates that 35,000 2-horsepower units similar to that described above could be set up on one square mile of ground, a square mile of desert thus producing 70,000 horsepower. Thus he believes that it will be possible to turn over to the sun the job of running the world's machinery when our coal and oil supplies are exhausted.

5. New Knowledge of the Indians

Since this volume was originally written, the Smithsonian Institution has continued, through its Bureau of American Ethnology, and the Department of Anthropology of the National Museum, exhaustive investigations of the American Indians. For a long period the Institution has been assembling and making available in published form knowledge of the "redskins." The investigations have covered their classification into tribes and linguistic families; their languages, implements and pottery, customs, ceremonial rites, myths, music, and other phases of aboriginal culture. These studies are being continued, special emphasis being placed on the gathering of information from the few existing survivors

PLATE 111

Ivory needle cases collected by Mr. Henry B. Collins, Jr., from St. Lawrence Island, Alaska, showing the beautiful decoration characteristic of the Old Bering Sea culture



Typical Folsom points collected by Dr. F. H. H. Roberts, Jr., in Colorado

of certain tribes that appear to be on the verge of extinction. But two of the outstanding Smithsonian investigations of recent years have related to another phase of Indian research—the study of the very earliest material evidences of man on the American continent. These investigations are the archeological work of Hrdlička and of Collins on the prehistoric peoples of Alaska, and that of Roberts at a habitation site of the so-called Folsom man, believed to be the oldest culture level thus far found in America.

Alaska is a key locality for students of the origin of the American Indian. There is general agreement among anthropologists that Bering Strait, that narrow strip of water between the easternmost point of Siberia and the coast of Alaska, formed the migration route over which the natives of Siberia reached the shores of America, there to spread rapidly over the whole of the two American continents. Many Smithsonian expeditions have attempted to find definite evidences of this migration, but thus far without success chiefly because of the rapidly changing shore lines of Alaska. Much information, however, has been gleaned regarding the prehistoric inhabitants of the region and the sequence of the ancient cultures. Beginning in 1926 Dr. Aleš Hrdlička has led 10 expeditions to various parts of Alaska and its neighboring islands, and his years of intensive studies he has summed up as follows:

"Since 1926, the beginning of these explorations in Alaska, it has been clear that there were two physically distinct varieties of the Eskimo, and it now is seen that at one time there were also two varieties of men in the Aleutian Islands. Moreover, neither of the types in the Aleutians were identical with either of the true Eskimo types, and though somewhat related to them they were at least equally related to the Indian.

"The far Northwest of the American continent contains thus no less than five distinct though basically related strains of the native man. These are: 1, the long- and

high-headed Eskimo of the Seward Peninsula, Barrow, and generally eastward to Labrador and Greenland; 2, the broader- and medium- to high-headed Eskimo of East Cape, the Diomedes, Norton Sound, the rivers from Yukon southward and the proximal parts of the Peninsula; 3, the broad- and low-headed late Aleut, extending from the central parts of the Peninsula and the Aleutian chain, some of whom still live in those regions; 4, the oblong-medium to high-headed pre-Aleut, in individuals somewhat Eskimoid, in others more Indian in their characteristics, extending originally over all the Aleutian Islands and to Kodiak; and 5, the Indian tribes of the great rivers, Cook Inlet, and farther eastward. These Indian tribes themselves present two or three different strains: the oblong-headed Shageluks, the interior Tinneth (Dene) tribes, and the Thlinkits or Kolushans of the Gulf region and southeastern Alaska.

"There are no clear lines of demarcation, however, between these different types; their averages, especially in the male adults, differ distinctly, but their extreme measurements connect, especially in the children and women. This is particularly true of the broad-headed Eskimo, the late Aleut, and the Cook Inlet and more eastern Indians. The whole region impresses the observer as a human 'nursery' constituted by several related strains of Asiatics, from which either the pronounced Eskimo or typical Indian could readily have developed."

Mr. Henry B. Collins, Jr., also has made a number of expeditions to Alaska, seeking particularly to trace the ancestry of the present Eskimo. A recent Smithsonian publication summarizing his findings concludes as follows:

"The recent excavations in northern Alaska have thrown considerable light on the problems of Eskimo prehistory, but they have by no means provided the final solutions thereto. They have revealed an ancient Eskimo culture which is seen to have been ancestral to the existing phases, and yet, paradoxically enough, this Old Bering Sea

culture is in many respects a more highly developed, a more specialized Eskimo culture than any other known. This can only mean that we must extend our search still farther into the past if we are to find the simple beginnings of this old culture and presumably, therefore, of Eskimo culture generally.

"Although we are unable to say just where and when the Old Bering Sea culture arose, there can be no doubt as to the general direction in which we must turn in seeking its origin. This is northern Eurasia, the region in which we find numerous striking parallels to Eskimo culture, and the only region where we find on the one hand the geographical conditions essential to the establishment of a settled maritime culture based on the hunting of sea mammals, and on the other hand, either existing today or having existed in former times, such basic Old Bering Sea elements as the square wooden earth-covered house with entrance passage, skin boats, sledges and toboggans, the harpoon with toggle head, throwing board and bird dart, lamps, pottery vessels, chipped stone and rubbed slate implements. These elements are found widely distributed throughout northern Eurasia, and we may assume that they formed a part of the culture of those first peoples who followed the rivers to the Arctic coasts and who somewhere between Bering Strait and the Kara Sea developed a culture which embodied the general features of Eskimo culture as we know it in its earliest western form. As to the immediate origin of the Old Bering Sea culture, the present indications point to northeastern Siberia, somewhere between the mouths of the Anadyr and Kolyma Rivers, as the area in which the culture in the specific form that we know it came into being."

The archeological finds of a peculiar type of projectile point and other artifacts made by the so-called Folsom man are attracting much attention at the present time because they represent the oldest culture thus far known on the American continent. The Folsom points, which are

thin, leaf-shaped blades with a rounding or a tapering tip and with a longitudinal groove or channel flaked out of each face, have been known from various parts of the United States for many years. They had not aroused any particular interest, however, until some of these points were found in the years 1925 and 1927 in direct association with the bones of an extinct form of bison near the town of Folsom, New Mexico, from which town the points derived their name. These finds were hailed as perhaps the most important contribution thus far made to American archeology, as the association with extinct forms of bison furnished a reliable indication that man was present in America considerably earlier than had previously been supposed.

No further knowledge regarding the culture of Folsom man was forthcoming, however, until it was learned at the Smithsonian in 1934 that finds of Folsom points and other types of chipped tools, with indications that they had been made at the spot where they were found, had been made by Maj. Roy G. Coffin and his brother on land owned by William Lindenmeier, Jr., near Fort Collins in northern Colorado. In September of that year, the Smithsonian sent Dr. Frank H. H. Roberts, Jr., of the Bureau of American Ethnology, to the site, and on the second day of his tour of inspection in company with the Coffins, an undisturbed implement-bearing layer was located along the bank of a ravine 14 feet below the present ground level and 12 feet above the bed of the ravine. Work was started at once by Dr. Roberts and continued for nearly 2 months, with the result that for the first time a site definitely known to have been occupied by Folsom man, with an extensive complex of his implements, was brought to light.

During the work of that and succeeding seasons at the Lindenmeier site, Dr. Roberts unearthed not only many examples of the typical Folsom point, but also scrapers, bevel-edged tools, gravers, knives, blades and choppers,

Ghostly, fantastic shapes of stalagmites and stalactites in cave at Mount Etna, Maryland

PLATE 114

Doi Chiengdao, Siam, whose summit was reached by Mr. Deignan while collecting for the Smithsonian. Only six Europeans had previously reached the top

and other worked objects, besides bones of an extinct form of bison, the extinct American camel, and other animals hunted by the Folsom men. The cooperation of Prof. Kirk Bryan and Louis L. Ray, of Harvard University, was obtained to determine the geologic age of the strata containing the Folsom remains. The advances and retreats of the ice during the last ice age are marked in the area of the Lindenmeier site by moraines, and from a study of these the geologists concluded: "Thus the Folsom culture of this area, and the Lindenmeier site in particular, have an antiquity which is between 10,000 and 25,000 years, if the errors inherent in the methods used are not too great. These methods have been very thoroughly reviewed. It is obvious that much more confidence can be placed on the statement that the culture is older than 10,000 years, than on the statement that it is as old as 25,000 years. However, it is believed by the writers that the age must be much nearer 25,000 years than 10,000."

To summarize what we know of the mysterious Folsom man and what can legitimately be surmised, let me quote from Dr. Roberts' report made at the end of his second season's work at the Colorado site.

"No human remains have been found, and so far as his physical characteristics are concerned, Folsom man is still a *persona incognita.* There is no evidence as to what type of shelter he may have used. On the other hand it seems obvious that he was a typical hunter depending entirely upon the bison for his maintenance and sustenance. He no doubt supplemented his preponderant meat diet with wild seeds and 'greens' but did not cultivate his own vegetal food. He probably did not settle long in one place, but traveled wherever the bison moved, in order to support himself. For that reason it is not likely that his dwelling consisted of anything more substantial than a tent made from the skins of that animal. Traces of the places where he pitched his shelter will be extremely hard to find at this late date. A hard packed floor and hearth, perhaps some

post molds, is the most that can be expected. He probably tarried as long at the Lindenmeier camp as he did at any of his settlements, possibly longer than at most of them when its advantages are recalled. Hence the chances of locating a lodge site or even of uncovering his own remains are not altogether beyond the bounds of likelihood.

"The old valley bottom with its numerous meadows, marshes, and bogs undoubtedly attracted bison because of the reeds and sedge grasses for feed and the mire in which to wallow. It is not likely that large herds frequented the district—rather that small groups drifted in from the plains to the east. The presence of the animals would draw Folsom man into the area, but in addition there were the assets of raw material for use in making implements, a good supply of water, firewood, and a pleasant camping spot. Here he could stalk his game, cut and dry the meat not wanted for immediate consumption, tan the skins, make his tents and such clothing as his needs required, fashion his tools from the available stone, and prepare his equipment for the inevitable trek when the bison shifted to other pastures.

"Present indications are that the Lindenmeier site was not occupied continuously by a large group of people. It probably was an annual summer and fall camping grounds visited regularly over a period of years by smaller parties. That the intervals between occupations were not protracted is shown by the homogeneous nature of the layer in which the artifacts are found."

6. *Continuing the Scientific Exploration of the Earth*

On the Beaches of the Dead in the Honduras interior; in the stygian blackness of an underground river on the island of Barbados; on the perpetually frozen strand of an inaccessible island off the coast of Alaska; at the highest peak of Doi Chiengdao, a Siamese mountain whose summit has been reached by only six Europeans—these are some of the unusual collecting grounds reached by recent Smith-

sonian expeditions. For in certain of the branches of science cultivated by the Institution—notably geology, biology, and anthropology—field work plays an essential part through the collecting of specimens and the recording of observations in little-known regions. Since the original printing of this Series, the Smithsonian has continued to send out scientific exploring expeditions which have visited not only nearly every State in the United States, but also every continent on the globe and many of the islands of the sea.

In the chapter in this volume entitled "Exploring to the Ends of the Earth," I quoted a number of extracts from the reports of Smithsonian field parties to show the character of the work and to try to picture some of the interest and even excitement and danger involved in certain of the expeditions, although of course the scientific results are all that count to the workers themselves. Continuing the same method here, I shall present excerpts from the reports on one recent expedition each to represent the three branches of science mentioned above. In geology the objectives of the expeditions vary from the locating and collecting of the fossil remains of dinosaurs and other extinct creatures to the collecting of mineral and gem specimens, all for the exhibition halls and study collections of the National Museum. A graphic description of the beauties of a newly discovered cave—strangely enough in Maryland not far from Washington, D. C.—was given by Mr. James H. Benn, of the Museum geological staff, who in 1932 made a number of short trips to points in the Atlantic Coast States in search of needed mineral specimens. Mr. Benn writes:

"In October 1932, the writer experienced the thrill of being the first to investigate a cave which had just recently been discovered at Mount Etna, near Beaver Creek, Md. From the opening on the side of a hill one descends by a short but strenuous journey into a large rotunda with a dome some 20 feet high. In the middle of the dome hangs

an elaborate and massive stalactitic growth resembling a huge ornate chandelier. Flanking this on either side hang curtainlike growths which add charm to the whole setting. Three main passageways lead off into the darkness, two of which leave the rotunda almost side by side. These twin corridors are guarded by man-sized stalagmites resembling ghosts with capes drawn to shield themselves from light in this abyss of eternal darkness. Along the walls are row on row of stalagmites, almost, it seems, standing at attention while the procession passes. From the ceiling hang stalactites of innumerable sizes and forms. The descent becomes steeper and progress becomes more difficult, for the passageway has widened, but the floor has become a forest of stalagmites of all sizes. The fore part of the cavern was striking, but this portion is splendid. Gleaming white stalactites covered with drusy crystals of calcite hang among growths of rich brown and yellow. Pillars, towers, fairy grottoes, steeples, castles, and polar scenes are there for the lively imagination. Deposits of mushroom growths and sparkling calcite enchant the eye. The passage is narrow but long, and every foot of the way is packed with something new. Most curious of all are stalagmitic growths on the floor with convolutions that resemble those of a human brain.

"Permission was granted by the owner to take out a grotto at some future date for exhibition in the National Museum."

Smithsonian biological expeditions are most varied in scope. They include the collecting and field study of mammals, birds, fish, insects, crustaceans, and many other forms. The fauna of certain parts of Siam was but meagerly represented in the National Museum, and for several years Mr. H. G. Deignan has been collecting in that country for the Museum. Of his ascent of the little-known Siamese mountain Doi Chiengdao, Mr. Deignan says:

"In March Doi Chiengdao, a great massif of metamor-

phosed limestone more than 7,000 feet high, was revisited; its summit has been reached by only six Europeans. Camp was made at 4,500 feet, near the highest spring, at this season all but dry, and a miserable week was spent here, tormented by insects and endangered by forest fires, which were devastating the stands of pine. The summit of the southwest pinnacle, exactly 7,000 feet above sea-level, was reached; there was no path, and much of the ascent consisted in scaling hazardous precipices of crumbling rock. In spite of the lack of water and the sun-dried vegetation, fresh signs of a bear were discovered at the top, and the remains of a *Petaurista*, recently killed (perhaps by a leopard), were found. Birds, mollusks, and insects were collected. During the descent, the dry grass below us was set afire, presumably by a wandering party of hill-men, and we managed to return safely to camp only by going down a difficult cliff, which permitted us to reach an area where the fire had burned itself out. Return to the plains was made by a new route, along a ridge parallel to the southern face of the mountain, offering indescribably magnificent views of the precipices, which are among the highest and sheerest in the world. The day was enlivened by the sight of bear, sambhur, goral, and serow, as well as great flocks of *Cerasophila thompsoni*, one of the rarest of Oriental birds."

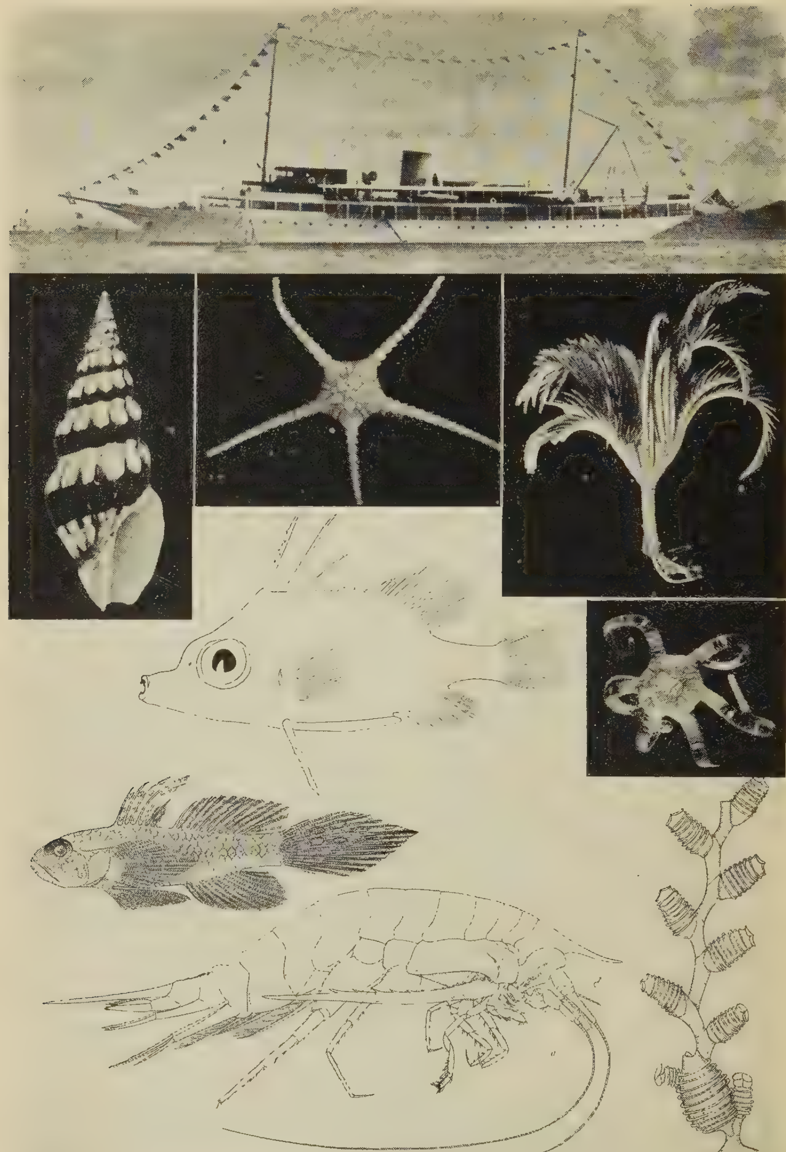
Field work in the interests of anthropology is perhaps the most varied of all. It includes the archeological excavation of ancient sites to bring to light the secrets of prehistoric peoples, the interviewing of old survivors of vanishing Indian tribes to save their knowledge of the ancient ways of their peoples, the study of tribal and linguistic relationships and migration routes, and reconnaissance work to locate promising sites for future investigations. One of these reconnaissance trips took Mr. M. W. Stirling, Chief of the Bureau of American Ethnology of the Smithsonian, to Guatemala, Honduras, and Yucatan in 1935 in search of promising ancient Indian sites. It proved to be

a most exciting journey, as will appear from the following quotation from his report:

"After leaving Lake Atitlán, we visited the interesting Indian town of Chichicastenango. Here a form of the ancient Mayan calendar is still used. In the hills nearby we witnessed the giving of offerings and prayer to prehistoric stone images of Maya deities. The houses of the town itself are constructed of adobe and stone, the Indians having at an early date adopted the Spanish style of architecture. On the floors of the old churches, now practically abandoned by the clergy, native altars are constructed and old rites still practiced. Standing in the candlelight of the old cathedral, the air hazy with the smoke of burning copal, and listening to the chants of the medicine men praying for little groups about the floor, one feels close indeed to the old religious life of the Maya.

"On returning to Guatemala City, we made plans for undertaking the more strenuous trip to the ruins of the great Maya city of Copán in northern Honduras. At this time, the press was filled with accounts of terrific earthquakes at Copán, which were reputed not only to have completely destroyed the isolated modern town but to have leveled the ancient monuments as well. For this reason it was with more than ordinary interest that we set out by rail to Zacapa, a town lying in the desert belt which stretches between the Guatemala highlands and the jungle-clad Atlantic coast. From Zacapa a hair-raising auto trip was made over a mule trail crossing a 12,000-foot mountain range, to Esquipulas, where in a broad, bare valley between encircling mountains stands the white structure which houses the shrine of the Black Christ, one of the most famous shrines of Latin America. Formerly a place of worship of a native deity, it became in early colonial times a Christian shrine and is still the object of pilgrimage for thousands of Indians who come from distant tribes and countries in order that miraculous cures may be effected for themselves or their relatives. At Esquipulas

Mound 26, Copan, after excavation showing hieroglyphic stairway. By courtesy of Peabody Museum, Harvard University



Mr. Eldridge R. Johnson's yacht *Caroline* used by the Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep, and a few of the hundreds of new life forms discovered

mules were obtained, and the long trip over rough trails through pine-clad mountains and grassy hills was begun. Upon crossing the border between Guatemala and Honduras, we reached the mountain valley of the Copán River.

"Our first view of the town of Copán revealed a peaceful cluster of white houses with red tiled roofs nestling among the trees at the foot of the mountain. Entering the town itself, a scene of destruction met our eyes. Practically every building had been badly damaged by the earthquakes, and the church, the most imposing structure of the community, had been almost completely destroyed. The earthquakes were still continuing at intervals and the frightened populace had erected tents and temporary structures in the town plaza or in open areas near the outskirts, where business was being conducted and where the townspeople were living.

"The ruins of the ancient city are among the most impressive in the New World. The elaborately carved stelae guarding the great courts and mounds impressed vividly on the mind a picture of the former greatness of the Maya. It is not difficult to imagine the reaction of the old conquistador, Palacio, who in 1576 left us the first description of this impressive site.

"We ascended the hieroglyphic stairway under the guidance of Gustav Stromsvik, of the Carnegie Institution, in order to view the last standing sculptured wall of the structure which had been erected as part of the ancient temple on top of the great mound. When part of the way up, we were forced to support ourselves by grasping the roots of trees growing out of the stairway as a heavy earthquake shook the place, accompanied by a loud rumbling noise. On reaching the top of the mound we discovered that the shock had collapsed the wall. After it had stood there for more than a thousand years, we were just two minutes too late."

Another type of Smithsonian expedition is represented by that of 1940 to Liberia, led by Dr. William M. Mann,

for the purpose of capturing live animals for the National Zoological Park. Financed by the Firestone Tire & Rubber Co., which maintains large rubber plantations in Liberia, the expedition established headquarters at Harbel, some 50 miles from the capital, Monrovia, and began its work of collecting.

Dr. Mann writes:

"With the aid of the Firestone Plantations' personnel we made a number of drives for antelope. The company is clearing vast areas of land in order to plant rubber, and there were some isolated forests left. We would surround one of these on one side with a line of rope nets, and then the white managers, leading their troops of employees, would form a ring and drive such animals as still remained in the forest. The natives in a long line would advance shouting, and the frightened animals running ahead of them would sometimes get entangled in the net. In this way we obtained a number of antelopes, among them three kinds of duikers seldom seen in captivity and at present the only representatives of their species in captivity in the United States or elsewhere."

At Belleyella, 5 days' walk into the interior, Dr. and Mrs. Mann were initiated into the famous Snake Society that exists throughout Africa. Of the ritual Dr. Mann says:

"In a dimly lighted hut we were kept at night for 4 hours. After taking the oath of secrecy we were taught high-signs, passwords, the procedure of entering a home, the manner of giving a present to a Snake Society brother or receiving one from him, and the symbolism of a large number of fetiches. Next day, inducted into the sacred bush, we were taught again more signs and landmarks, and the secrets of 36 different species of plants were explained to us. Some were medicinal, some used in sorcery. And then our fellow members of the lodge presented to us the ceremonial snake, a rhinoceros viper which we afterward sent to Washington. Because she was the first white

Restoration of the Dinosaur known as *Diplodocus longus*, as exhibited in the National Museum. This monster, whose fossilized bones were recovered by Smithsonian scientists in Utah, measures 70 feet, 2 inches in length and is 12 feet, 5 inches high at the hips

Refrigerated penguin cage in one of the new modern buildings at the National Zoological Park in Washington

woman who had ever lived in the village, and the second white woman who had ever joined the lodge, Mrs. Mann was made an officer, given a title and certain powers. As Yangwah, she has the authority to 'cut a palaver,' that is to end an argument, which is a valuable power in West Africa!"

Scientific exploration will always form an important part of Smithsonian activities, for only by its use can we increase our knowledge of the earth and of the life thereon. All of the land areas of the globe have now been entered upon by man, but there remains a vast amount of work to be done in comprehending the geologic changes taking place upon the surface of the earth, in untangling the relationships and evolutionary trend of the infinite variety of life forms, present and past, and last but not least, in delving into the unwritten records of man before history in order that we may more fully understand the status of the human race of today.

7. *Other Noteworthy Activities*

In all its other fields of activity the Smithsonian continues to advance. In biology, thousands of new life forms have been discovered, named, and described in the Institution's publications. This so-called taxonomic work is of fundamental character, forming the basis of all other types of biological research. Several recent Smithsonian expeditions have contributed largely to the increase in the known number of kinds of all sorts of creatures, both land and marine, notably the Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep in 1933, under the direction of Dr. Paul Bartsch, of the National Museum. Mr. Eldridge R. Johnson generously placed at the Institution's disposal his palatial yacht *Caroline*, which he had equipped with the most modern devices for marine dredging and collecting in deep water, and he further financed the expedition and the later publication of the scientific results. Thousands of specimens were collected by the expedition

and brought back to Washington for study by the Institution's experts in many branches of biology; among them were found hundreds of species hitherto unknown to science and many others never before recorded from the Puerto Rico region.

In the field of geology, basic work has been done on the fossil Foraminifera, Ostrocoda, Bryozoa, and Conodonts, all small fossils which serve to identify rock strata of vital concern to the oil and mineral industries. Fossil remains of many of the extinct monsters of millions of years ago have been located, brought back to the National Museum, and, where possible, restored for exhibition to the public in the halls of the Museum. Analyses of mineral specimens collected by the Museum staff and otherwise acquired have been made in the Museum laboratories, and a number of new minerals have been discovered. Research has been continued on the meteorite collection, and so many additions have been made to it that of the 1,200 definitely known falls of these visitors from outer space, the Smithsonian has more than half.

The collections of the National Museum continue to increase at an ever-accelerated pace. More than a quarter of a million specimens are added each year to the exhibition and study series. These come from Smithsonian expeditions; from other Government agencies; through the aid of certain funds recently established, notably the Roebling fund and the Canfield fund, both for the acquisition of minerals; and from miscellaneous sources. This steady growth in the departments of biology, geology, and anthropology has placed the National Museum collections unquestionably among the foremost series in the world. Furthermore, the technical and industrial collections have developed into series that compare favorably in volume, quality, and interest with those in other great technical museums of the world, and the historical collections have grown through large additions of memorabilia of famous men and events and through the development of large

collections of stamps and coins. Visitors to the buildings of the Smithsonian group have also increased steadily in number, the annual attendance now exceeding 2,000,000.

At the National Zoological Park, another branch of the Smithsonian, progress has been marked by a substantial increase in the number and quality of animals displayed, brought about in large part through the National Geographic Society-Smithsonian Expedition to Sumatra, headed by Dr. William M. Mann, Director of the National Zoo. Through the assistance of the Works Progress Administration, five new modern buildings have been added to the equipment of the Park.

The Institution has continued to publish and distribute throughout the world the results of its researches, and to summarize in popular form the yearly advances in all branches of science in the Smithsonian Annual Report. Most of the nearly 100 publications issued each year are short technical papers, but many of the larger monographs have been basic contributions to knowledge and are used as research handbooks by investigators in all parts of the world.

So the Smithsonian Institution, in all its lines of activity—its scientific researches and explorations, its museums and art galleries, its publications and national radio programs—continues to keep faith with its founder, James Smithson, by promoting "the increase and diffusion of knowledge."

The Smithsonian in Wartime

It might be supposed, at first thought, that scientific institutions and museums would have little part in the Nation's war effort. To show that such a supposition is far from the truth, I shall review briefly some of the wartime activities of the Smithsonian at Washington as an example of the part such organizations play in modern warfare. Scientific institutions, of course, vary greatly in the extent to which they are able to be of service, for each specializes

more or less in some broad field of learning, and the war demands depend on the applicability of that field of learning to war problems. The warfare of today, however, calls upon science to such an unprecedented extent that many of the least expected subjects of research prove to be of very practical usefulness. An example will illustrate this last point. For many years the Smithsonian has maintained very extensive collections of insects and has carried on and encouraged the study and exact classification of these collections. This would appear to be a purely academic and nonpractical field of investigation, but it turns out that in the far-flung regions of the earth where American troops served in World War II, insects are an important factor in the spread of disease, and the Smithsonian's division of insects has been called upon very frequently to identify such insects of medical importance.

Through its world-wide explorations, discussed at another point in this volume, the Institution has on its staff men who are familiar with remote areas of the world, many of which become of vital importance in wartime. At the request of the Army and Navy extensive reports on many such areas have been prepared and made available to the proper officials. Similar requests for photographs of strategic areas have also been met by the Smithsonian staff.

Studies of native peoples might likewise seem to be largely of academic interest, but actually under war conditions it becomes vitally important to know, for example, what a native of New Caledonia eats for breakfast and how he reacts to events and conditions. The Smithsonian's first-hand knowledge of the natives of far-off regions has been made available to appropriate government services, thereby easing the way for many an Army or Navy officer with no previous knowledge of the people of the region where he may be stationed.

The few examples cited above give the key to the Smithsonian's particular function in wartime: it is chiefly to fur-

nish technical and specialized information to the Army and Navy and war agencies—information which must be accurate and which is almost always needed quickly. The Institution also engages in war research work assigned to it, promotes extensive programs designed to further Inter-American cooperation and good-will, and its officers serve on numerous governmental and other boards such as the National Advisory Committee for Aeronautics, the National Resources Planning Board, the Committee for Cooperation with Latin American Republics, and others. But its outstanding contribution to the war effort is its service as a source of spot information and extended reports on war areas and peoples and on urgently needed scientific subjects and strategic materials.

Requests from war agencies have run nearly the entire gamut of human knowledge and experience. One day the Institution may be called upon to identify a mosquito from New Guinea, the next day to furnish a list of manufacturers of steam engines. Other requests vary from data on variations of the human features for use in designing oxygen masks to information on Japanese whaling activities. Particularly in demand have been the Institution's specialists on woods and fibers. Many questions have been answered relating to woods, their properties and substitutes for them, especially in connection with the building of ships and airplanes as well as military construction. Members of the staff have also furnished much information on new sources of supply, and of substitutes for rubber, silk, cork, rattan, and similar materials.

Much of the information furnished to war agencies was of a confidential nature, and details were not reported. However, a recitation of some of the subjects on which the Smithsonian was consulted will give an idea of the scope of the requests. Some of the topics were: Physical properties of cloth for uniforms, deterioration of cardboard and other packing materials, devices for obtaining drinking water from sea water, analyses of minerals and ores,

geology of the Pacific islands, oil-bearing strata in certain regions, shipworms and other marine organisms that affect ship bottoms, fisheries in many parts of the world, poisonous reptiles and plants of war areas, translation of Oriental languages, emergency food resources for marooned sailors and airmen, race mixtures, Arctic clothing, airplane models, hot-air engines, jet propulsion, and many others.

The Smithsonian editorial division devoted nearly all of its time to the issuing of a series of publications and press releases designed to create a wider understanding of the peoples and areas involved in the war. These were in wide demand by the Army and Navy as well as the general public. The Smithsonian library supplied the Army and Navy and war agencies with hundreds of publications and technical references needed in their work. In short, the Institution used every resource at its disposal to aid in winning the war. It is safe to say that many precious days and weeks were saved for those responsible for the conduct of the war by the ready availability in Washington of the Smithsonian's wide variety of technical knowledge.

CONCLUSION

When James Smithson made his will in 1826, and even twenty years later when Congress established the Smithsonian Institution, there existed nothing like it in this country. The colleges had some teachers who also did research work in science; a few men of independent means carried on occasional investigations; cultural centers like Boston and Philadelphia had institutions such as the American Philosophical Society which encouraged scientific activity; but nowhere was there a powerful organization devoted to the increase of knowledge of the natural and physical sciences, and possessed of means to make its purpose effective. With the exception of *Silliman's Journal* there existed practically no agency for the publication of the results of a scientist's labor unless the author was willing to bear the expense himself.

If institutions like the Smithsonian were unknown, it was because the temper of the people was not ripe for them. Modern science, except for the high priests who tended its altars, had no meaning; at least so much of it as could not be immediately translated into material values had not. That is why it took Congress eight years to determine what sort of an institution the Smithsonian should be. Smithson's purpose and his life presented a puzzle to the Congressmen because they involved conceptions which had not come within the ken of most educated men of that period.

James Smithson's bequest, then, when it took form under Joseph Henry, opened up a new field. It gave American science a rallying center; it inspired workers already in the field by supplying them an agency for

the publication and world wide distribution of their results; it brought great numbers of new workers into the field by focusing popular attention on research, by enlisting collectors and observers throughout the country, and by broadcasting instructions for scientific work; it fostered the activities of local organizations for the increase and diffusion of knowledge; it encouraged the growth of museums by gifts and advice; it made possible the establishment of Government scientific bureaus; in short, it served as "peculiarly the architect of American science."

The need for the pioneering work of the last century is past; the American people are scientifically minded enough to recognize the desirability of research. Some Foundations immensely rich, and many wealthy enough to do effective work, have sprung up in all parts of the country to prosecute research. Many of them are modeled even in their expression of purpose on the Smithsonian, and it is perhaps not unfair to say that the inspiration for all of them traces back to the Institution. But the important point is that these developments have changed in large measure the field of usefulness of the Smithsonian. There is as much to do, seemingly, as there ever was, but it lies in other fields.

The Institution strives to keep abreast of changing opportunities. This is the more easy because the principle of minimum overhead laid down by Secretary Henry keeps the resources fluid. The independent core of the Smithsonian is unfettered by commitments or prejudices. Its officers can and do take stock periodically of the condition of science and change the Institution's course in the light of their observations. Though its administrative burden increases constantly because of the growth of the Government bureaus under its care, and the imposition of new duties by Congress, yet the Smithsonian remains essentially an organization for the increase and diffusion of knowledge among men.

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